THE

ELECTRICAL REVIEW.

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THE MUNICIPAL ELECTRICAL ASSOCIATION ADDRESS.

THE longer we ponder over Mr. Wordingham's address to the Municipal Electrical Association at Manchester last week, the more does it seem to be a hastily conceived series of running comments.

Its purport was to indicate some of the directions in which the Association may increase its sphere of usefulness, but, as Mr. Wordingham himself admits, these had been so ably set forth last year by Mr. Arthur Wright, that it seems a pity that he should have suggested other directions which appear at once impolitic and impracticable. We do not say that there are no useful hints brought forward in this year's address, but the useful seems to be over-balanced by the more than doubtful.

For instance, the idea of turning the Association into a sort of exchange and mart for the sale of old electric lighting plant is scarcely the kind of thing for a professional body to engage in. When machinery is for disposal, we imagine municipal corporations are not the only would-be customers, and why should not the same method be adopted in disposing of plant no longer required as that usually employed when new machinery is necessary?

Corporations advertise their requirements; let them do so when desirous of getting rid of more or less useless encumbrances. Surely this is a preferable method of making known that certain engines, dynamos, &c., are for sale, to that of privately circulating such information amongst the the members of the Municipal Electrical Association. We do not think that the ends of progressive improvement and applied electrical science will be served by the institution of a sort of clearing house for municipal electrical plant, whereby second-hand and generally obsolete material can be hawked about in order that local authorities may pose before the ratepayers as economists; though, as we contend, false ones. Nor does such a scheme appear to be consistent with the encouragement to manufacturers to be ever improving on previous designs, which it is in the long run in the interests of the public to hold out. Such a course as that proposed would, we think, lower the professional status of the Association, and scarcely conduce to the "high standard of professional probity, uprightness and independence, and if you will, etiquette," which Mr. Wordingham very rightly urges upon its members to assume. Nor could they very well "live up to the traditions of the founders of the engineering profession, and save electrical engineering from becoming *a mere trade*, with the sordid appendages too often connected with commerce," if they turn the Association into an agency for the buying and selling of plant. What does Mr. Wordingham hope to gain by such a strange procedure? Does he think that a member of the Association is going to deal less interestedly when selling to a brother municipal engineer? If he did he would hardly be doing his duty to his own employers, which clearly is to get

the best market value that he can. It is not likely for the same reasons that he will underrate the performance and condition of the apparatus he desires to vend, and we fail to see where the considerable advantage to members would come in.

"One corporation," said Mr. Wordingham, "with the full approval of the contractor has nominated the President of the Association as arbitrator in the event of disputes arising under certain contracts, and it seems probable that arbitration will be one important function of the Association in the future."

As a step in the direction of introducing the principle of independent arbitration as between buyer and seller in connection with electrical contracts we altogether approve this precedent. But that the Association is destined to exercise judicial functions through its President for the time being in cases of electrical contractors' disputes generally we venture to doubt. Firstly, because the Association is bound up with a certain class of interests, and is therefore not disinterested. Secondly, because the municipal electrical engineer is, generally speaking, at present lacking in age and experience without which a man is not qualified to sit in judgment on his fellows.

But perhaps the most extraordinary proposition put forward by the worthy President is that of allowing the station engineer to add to his income by taking engineering pupils. "There is everything to recommend the practice," says he, "and nothing substantial against it." "The services of the pupil are of value to the Corporation, and they tend to diminish the cost of production inasmuch as they are rendered without payment."

Mr. Wordingham, therefore, advocates that the premiums of pupils should be handed over to the engineer, in some towns admittedly well paid, as a ready means of increasing his salary without an undue augmentation of the works' costs, a percentage going to the principal assistant for the portion of the work of teaching which would fall upon him.

This is the President's ideal arrangement of staff:—

Each year a certain number of pupils (say three), would be selected carefully by the engineer from men who had just completed their education at a technical college, and who had, if possible, had experience for a year or two in mechanical workshops. Such men would be useful very soon. They would be articled for two years. At the end of that time, if vacancies existed they would become junior assistants, and would be paid a moderate salary. If no vacancies existed, they would readily find employment as assistants in smaller central stations. When they had become assistants, or had left, there would be in the works three pupils each with a year's experience, and three new pupils. Those who were selected to remain as junior assistants would be competent to take charge of a shift, and would remain with small annual increases of salary as assistants until the principal assistant left, or some suitable berth offered in another station. The chief assistant would have under him the junior assistants, and it should be the policy of the Corporation to retain this chief assistant permanently, provided, of course, that he renders loyal and efficient service to the undertaking. They then have an understudy for their chief engineer should he relinquish his post or succumb to the wear and tear of its responsibilities. Briefly, then, the chief engineer and his principal assistant should be encouraged in every way to remain as fixtures, while the fact should be faced that there must of necessity be a constant succession of junior assistants, the supply being kept up by means of pupils trained in the works where they will be required.

We cannot conceive any business-like Corporation assenting to such terms. Without considering whether there is even anything to recommend the practice, its abuses might certainly outweigh its uses. Mr. Wordingham was in all conscience sufficiently severe and scathing in his condemnation of the methods adopted by consulting engineers for securing employment, but his ideal suggestion looks very like setting a premium on offering one's services to a Corporation at the lowest salary for the sake of the fees obtainable from the three pupils per annum, and the methods of the present consulting engineer might well be outdone by the very men from whom Mr. Wordingham expects the ranks of the consulting engineer to be largely recruited.

And if 20 per cent. of the existing stations were each blessed with three promising youths at the present moment, where are we to expect the new stations to arise to absorb these budding municipal engineers at the end of two years? It is all very well to say they would readily find employment, but will this be the case? Mr. Wordingham seems to have overlooked the fact that he had just previously stated: "Whatever the system of supply adopted, there is in every station a large amount of detail work peculiar to that station, and no stranger coming in fresh to work is of the slightest use as an assistant until several months, or at any rate a good many weeks, have elapsed."

The "boom" in electrical engineering pupils of some years ago is still painfully fresh in one's memory. Some contracting firms made more profit from premiums than from work done, and many pupils at the end of their time, occasionally before, were thrown upon their own resources, and became inspectors of public buildings, outside. It seems that the only difference between the past and the present lies in the occupation of those who, it is now suggested, should train the youthful mind, and a recurrence of the past is scarcely to be desired.

Experience extending over many years in other branches of engineering has demonstrated conclusively that the system of allowing pupils as a "perquisite" to superintending engineers is an unsound one. There may be exceptions and survivals at the present day; but the position of the pupil in such instances is a false one, because he has two masters to serve—the engineer to whom he is apprenticed, and the employer, of whom the engineer himself is a servant. Complications constantly result, and both engineer and pupil end by finding themselves deprived of the ability to perform that single-minded service on which duty and ultimate success are alike based.

We are somewhat surprised to find no allusion in Mr. Wordingham's otherwise able address to the vexed question of standardisation of central station plant, and the conditions under which such plant should be constructed and installed by the manufacturer. All are aware that the manufacturer and contractor—who, after all, is the genesis of the very goods which the municipal engineer exists to maintain—has been seriously prejudiced in his business, ever since the dawn of central station supply, by the idiosyncracies of the consulting and station engineer, and the cumbersome methods adopted by municipalities in their dealings with contractors. This is a direction in which it appears to us that work of an invaluable character can be performed by the Municipal Electrical Association.

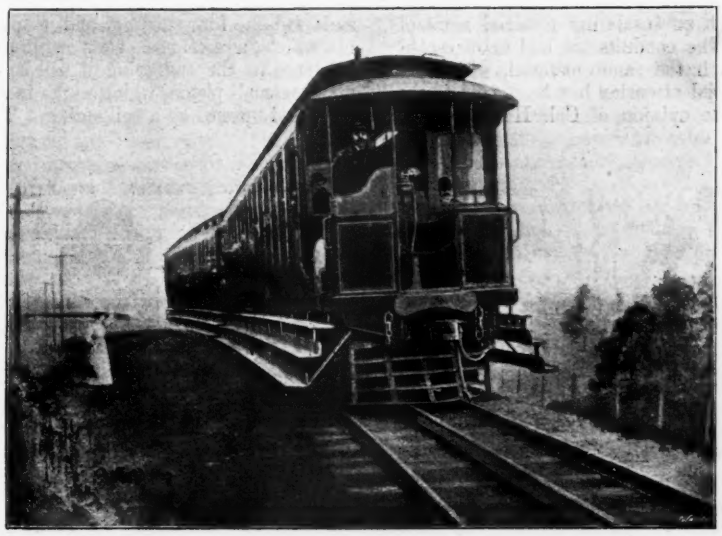
There are other points in the address to which one could take some exception, but we must remember that Mr. Wordingham's utterances do not necessarily represent the views of his colleagues, the majority of whom we are fain to believe have already revolved in their own minds the same thoughts which have occurred to us.

While we desire to congratulate the President of the Municipal Electrical Association upon the high standard of professional and commercial etiquette which he has held up for adoption by his colleagues, and share in his hopes of its future usefulness, we cannot refrain from observing that the programme presented to us is something ambitious, and the menu sufficiently rich and varied to threaten the digestive powers of so young an organisation. If we remind the Association of the advice to "fling away ambition, by that sin fell the angels," we do so because we conceive it has much valuable work to do on soberly conscientious lines before embarking on some of the higher planes of more precarious foothold foreshadowed by the President.

THE THIRD RAIL SYSTEM ON THE NEW HAVEN RAILROAD.*

The third rail system of electric traction is now in permanent operation on an important section of a leading steam railroad. The recent opening of the line from Berlin to New Britain and from New Britain to Hartford, while it is by no means the first successful operation of third rail traction, is notable as being its first application in a permanent way to the lines of a standard steam railroad.

The first extensive test of this system took place within the grounds of the World's Fair, at Chicago, where its operation was very satisfactory. It was then adopted on the elevated roads of Chicago, where it has given reliable service. The Brooklyn Bridge trustees decided that it was adapted to the requirements of bridge traffic, and laid a third rail on the outside of the tracks. The equipment has given a good account of itself, especially in the switching operations at the terminal stations.



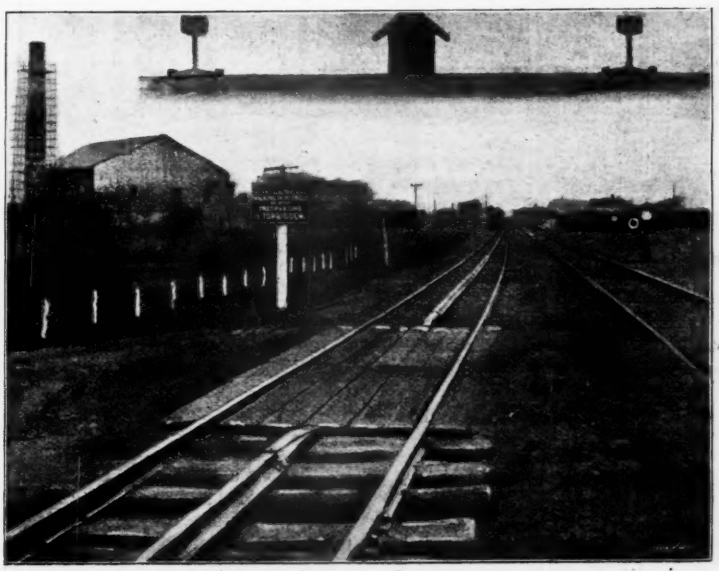
Train Consisting of a Motor Car and One Coach Running at Full Speed.

It is stated by Col. N. H. Heft, chief of the electrical department of the New York, New Haven, and Hartford Railroad, who has afforded us every facility in the preparation of the present article, that the probability of electricity entering largely into the operation of steam railroads was suggested to the directors by Mr. Clark in his annual presidential report made in 1891. It was natural that the attention of this company should be turned to the question of electric traction, for the reason that their passenger traffic was being exposed to severe competition from the network of suburban and interurban trolley lines which have sprung up throughout the country served by the New Haven road. Fully one-half of the gross receipts of this road is realised from passenger traffic, and a large proportion of this is obtained from local traffic, of a character for which suburban trolley car service has most attraction.

The first step taken by the company was to form an electrical department, and give orders for the electrical equipment of a stretch of their road which runs from Nantasket Junction to Pemberton, Mass. This equipment, which is commonly known as the Nantasket Beach line, was put in operation in 1895. Overhead conductors were used and the experiment was highly successful. The company then determined to test the third rail system of transmission, and a trial line was laid down in 1896, when an additional 3½ miles of road was placed in service. The operations at Nantasket were regarded by the company as being experimental and preparatory to a further extension of the system. The results were so promising that it was determined to apply the system on a larger and more permanent scale, embodying in the new line the results of previous experiments.

The equipment which has recently been put in operation is applied to two lines of steam railroad, one extending from New Britain to Berlin and the other from Hartford to New Britain, the total length of the line from Hartford to Berlin being 12·3 miles.

The power station has been built with a view to its enlargement as the electric equipment is extended. The building is 106 feet wide by 117 feet in length, the end on which the extension will be added being temporarily walled in with wood planking. The present building contains two stories in the front devoted to the engine and generators, &c., and a boiler room in the rear extending the full height of the building. A 1,200 horse-power engine is already in place and the foundations have been built for a second. There is room in the building for a third engine when the extension of the line calls for it. Further details regarding the engines and the boilers will be given in a later issue. The engine is direct connected to a General Electric Company's standard 10 pole, 850 kilowatt generator of the well known ironclad type, which furnishes current at 600 volts no load and 650 volts full load.



View of Road Crossing and Cross Section of Track.

The third rail conductor is of a special section rolled for this purpose. It resembles somewhat a flattened A, the flanges forming a protection to the insulating blocks upon which it is laid. The rail is heavy, weighing 93 lbs. to the yard, and it is found that wooden blocks saturated with insulating material give excellent service, and three to the rail are found to be sufficient. The flanges of the rail come within 1½ to 1⅝ inches of the top of the ties, the head of the rail being one inch higher than the main rails. It will be seen that this conductor is carried much lower than that on the Nantasket line, the difference being due to the height of the main rails. The ends of the rail are bonded by sheet

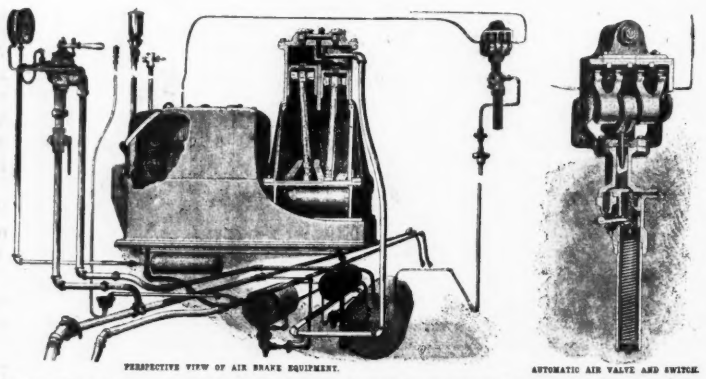
* *Scientific American.*

copper plates ⅛-inch thick, 4½ inches wide and 12 inches long, which are held against the under side of the flanges at the rail ends by iron plates. The latter are bolted to each rail by 16 bolts, 8 for each plate, the copper bonds being sandwiched between the iron plates and the rail. The capacity of each bond is 900,000 circular mils, the double bond having more than the carrying capacity of the rail itself.

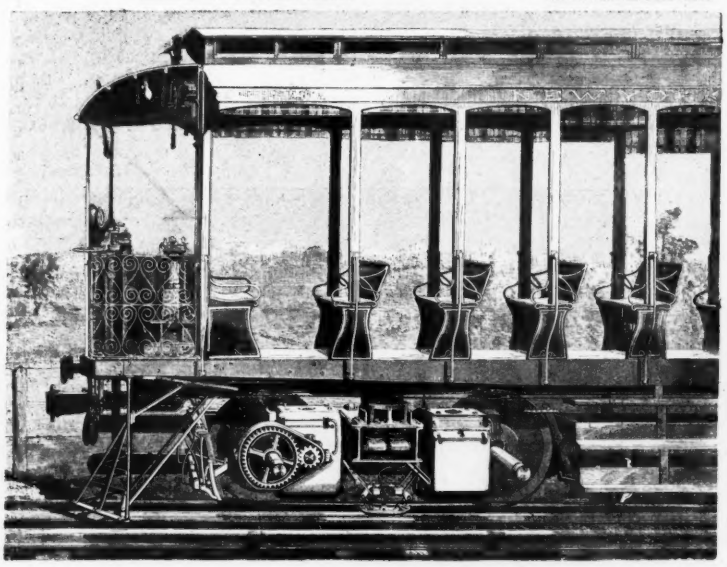
On the whole line there are 22 grade crossings, at each of which the third rail is replaced by underground cables of 850,000 circular mils. The cables are drawn into creosoted wooden conduits filled with an insulating material made of residuum and asphalt. The conduits are laid in creosoted wooden troughs filled with the same material, which are buried in the earth. Special attention has been paid to the return circuit, as it is the opinion of Col. Heft that the importance of this element is too often overlooked in the construction of electric roads. The company has put in leaf bonds of 550,000 circular mils, and these are attached to the base of the rail in preference to the web, and are secured by wedge fastenings. In order to prevent any interruption to the current when a train is passing over switches and crossings a shoe is provided on the rear car of a two-car train. This insures that connection will be made by the shoe of the motor car before the shoe of the second car has entered the gap.

The general appearance and mechanical details of the open cars are shown very clearly in our illustrations. They are 51 feet long, and are provided with 16 seats, each of which can accommodate 6 passengers, the capacity of a two-car train being, therefore, 192 passengers. The current is taken from the third rail by means of a sliding contact shoe, which consists of a simple cast-iron plate 5 inches wide by 12 inches long, weighing about 12 lbs. It is carried by an insulated support, to which it is fastened by jointed links, which allow it to bear upon the rail at all times with a pressure due to its own weight. Each train is made up of a motor car and a trailer. Each motor car has two 125 horse-power motors, both of which are mounted upon one track, as shown in the accompanying engraving, in which the casing has been removed to show the gearing of the forward motor.

It can well be understood that in a service of this kind, where the high speeds which are customary in the steam service are to be regularly made, special attention had to be given to the question of braking. As hand-operated brakes were out of the question and steam was not available, it was determined to equip the motor cars with a separate electrically driven air brake plant. The details of this successful and highly creditable work are shown in the engraving, and its position on the front platform is shown in the side view of the car.



PERSPECTIVE VIEW OF AIR BRAKE EQUIPMENT. AUTOMATIC AIR VALVE AND SWITCH.



FRONT END OF MOTOR CAR.

The two-cylinder, single acting compressor is driven by a direct connected 10 horse-power motor. The compressor has a capacity of 52½ cubic feet of air per minute under a gauge pressure of 90 lbs. per square inch. The speed is 250 revolutions per minute and the consumption 16 amperes at 600 volts. The standard Westinghouse air brake equipment of the company is used on the cars, and it is controlled by the usual engineer's valve, as shown in the engraving. One of the most ingenious features is the automatic valve and switch for starting and stopping the compressor, of which a sectional view will be found below. By reference to the engraving it will be seen that air is led in above a small piston, which works in a vertical cylinder and is pressed upward by a coil spring. The spring is set at the working pressure of 90 lbs. to the square inch. As soon as the air pressure exceeds 90 lbs., the piston is forced down, carrying with it a small vertical valve stem and allowing the air to pass up into a small cylinder located beneath the electrical switch which controls the motor of the air compressors. Here it pushes up a piston which throws over the electrical contacts and opens the switch. As the air pressure falls it releases the lower piston, which rises to its normal position. As it rises, a catch on the piston rod lifts the small lever shown to the left and opens a release valve below the switch cylinder above mentioned. The upper piston now falls and closes the switch, thereby starting the motor of the air compressor. The device has given complete satisfaction. It may be set to work at from 45 to 100 lbs. pressure, and on a variation of from 5 to 7 lbs. pressure.

The air compressor is placed, as shown, on the front platform of the car to the left of the motorman. In front of the compressor is the wheel of the hand brake, and conveniently arranged in front of the motorman are the pressure gauge, the engineer's air valve, and the controller. The lever for operating the air chime whistle passes through the hood just above the motorman's head. Beneath the hood on the front of the car above the door are the current breaker and the main switch. On the front rail of the platform there is also a conductor's signal whistle.

The current passes from the shoes through flexible copper cables to the circuit breakers. After passing through these it is led through a lightning arrester and a "kicking coil." It then divides, passing to the controllers on each platform. At each controller it passes through a magnetic blow-out coil, and is led by cable to the resistance situated in the centre of the car. It then returns through the resistance contacts to the controller cylinder and the motors.

The danger to the public from the use of the third rail is

considerably less than is popularly supposed, and in view of the precautions which have been taken to safeguard the ignorant or unwary, the chance of accident is very small. At the Berlin and Hartford stations the third rail section is fenced in on both sides. At New Britain, where the two lines converge, a switchman's tower has been built in the Y where the roads converge. Underground cables connect the rail where it enters the station with a switchboard in the tower. When a train has stopped in the station the third rail is cut out, and it is not thrown in until the train is ready to start again.

When the road which has now been electrically equipped was operated by steam, eight trains a day were run each way between Hartford and New Britain, and 14 trains a day between New Britain and Berlin. Under the present system two-car trains will be run every half-hour between Hartford and New Britain from 6 in the morning till 12 at night. The run of 9·3 miles will be made in something under 20 minutes, and the fare will be 10 cents each way. Sixteen trains a day will be run between New Britain and Berlin, a distance of 3 miles, the fare being 5 cents for a single trip.

We reserve further particulars and illustrations of this interesting plant for a later issue.

THE DÉRI SYSTEM OF ELECTRIC TRACTION.

A new system of electric traction has been brought out in Vienna, which is said to combine all the good points of previous systems, and none of their disadvantages. This system, invented by Max Déri, professes to have solved the problem of applying electric traction to ordinary railways. With the tension of 500—600 volts at present used on electric railways, it is not possible to economically transmit power to the cars to a greater distance than about 6 miles from the power station. The only method of getting over the losses due to long distance transmission is to use high tension alternating currents to transmit the power to sub-stations where it is transformed down to a working pressure and supplied to a local section of the trolley wire.

Many difficulties, however, have hitherto stood in the way of applying these transformed alternating currents. In the case of single-phase alternating currents, there is in the first place the difficulty that the alternating current motor, though simple in its construction, and quite as efficient as the continuous current motor, is yet not capable of starting under full load, and permits no change of speed. In the case of polyphase motors, the difficulty of starting under full load disappears, but the variation of speed is still to a certain extent limited by the frequency and the number of poles of the magnet.

Accumulators have been used for electric traction with great success; and, indeed, accumulators are in certain respects remarkably suited for this purpose. In the first place, accumulators act as buffer batteries, and thereby help to equalise the extraordinary variations of the load that occur in electric traction. If the accumulators are placed in the car itself, they permit the application of lower voltages, and thereby the use of shunt motors, which, as is well known, have many advantages over the series motor. With the shunt motor, the regulation can be very economically effected by changing the resistance of the shunt, or subdividing the battery; and moreover, when running down an incline, or stopping, the shunt motor may be used as a generator to charge the battery, and thereby act as an exceedingly economical brake.

The great weight of the accumulators would be an objection to their exclusive use for driving cars, but this objection does not apply to the comparatively small batteries which are only to be used on certain occasions.

The Déri system is an attempt to get rid of the objections to the systems discussed above, and to retain what is best in each.

Déri makes use of high tension currents (single or polyphase), which are transformed down at any required number of sub-stations, and supplied to the trolley wire. In the motor car, or on the electric locomotive, let us suppose that there are an even number of motors, one-half of which are alternate current motors, and the other half direct current motors of the shunt type. In addition, every motor car or locomotive carries a small battery of accumulators.

The starting is done by the direct current motors, which are supplied with current for this purpose from the accumulators. When a certain speed is reached, the alternate current motors are switched on, and now these are either helped in their work by the direct current motors, or they alone do the whole tractive work, or lastly they develop an excess of power which drives the direct current machines, converting them into generators, which charge the accumulators. In stopping the car or train, the alternate current motors are first switched out, and then the greater part of the *vis viva* of the car is usefully absorbed by the direct shunt machines which store it up in the accumulators. Finally, the direct motors are switched off, and the car brought to a standstill by mechanical brakes. All these switching operations in their proper order are effected by simply turning a regulator crank.

The arrangement of the trolley wire in the Déri system is very simple, since at points and crossings, and at stations, the cars are driven by the accumulators. The trolley wires are, therefore, everywhere parallel, and there is no difficulty in such circumstances in using an overhead insulated return wire. Such an arrangement has the great advantage that the induction effects on neighbouring telephone wires are very much reduced.

Where the extra expense forbids the use of the overhead return, the frequency of the alternating currents may be reduced below the limit of the lowest audible note; a periodicity of 20 will be sufficiently low for this purpose.

The Déri system is also free from certain disturbances which are inherent in direct current systems. The small and rapid variations caused by the commutators of the generator and of the motor are propagated along the wires, and transmitted by induction to the telephone circuits. As there are no commutators connected with the line in the Déri system, this kind of disturbance is not present. The disturbances due to the great variations of current caused by starting and stopping the cars, are obviated in the Déri system by a specially designed regulator, which utilises the accumulators in such a way that the flow of current in the trolley wires is remarkably uniform.

A great economy is introduced in this system by means of an appliance worked by the car battery, which switches current on to each section of the line only when it is actually in use. This is done by making or breaking the primary circuit of the transformers at the sub-stations.

A full description of the Déri system, and an enumeration of a large number of advantages it possesses in addition to those mentioned above, will be found in the *Zeitschrift für Elektrotechnik*, June 15th, 1897. If the system achieves all that is claimed for it by its inventor, it will, indeed, bring about a revolution in electric traction.

POINTS IN PRACTICE.

The May issue of our very excellent contemporary, the *American Electrician*, contains the following notes on subjects full of interest to practical electrical men.

Mr. H. E. Raymond, of Norwich, Conn., writes on "Alternators in Parallel," and says:—

"I have been considerably interested by the different letters relative to the paralleling of alternators, which have appeared in the issues of March and April. I agree with Mr. Paul M. Lincoln that the 'useful' output of alternators in parallel depends upon their relative speeds. The causes of differences in the form of wave, however, may also cause differences in the armature reaction of each machine, and if the load varies, the field excitation can hardly be adjusted accurately and rapidly enough to prevent synchronising or cross currents. These currents may, perhaps, not be properly called a part of the output, but their heating effect may, and generally will, cause serious inconvenience.

"If the alternators have approximately the same armature reaction and regulation, or if they will carry the same loads with the same corresponding voltage, the best way to run them is as follows:—First find the amount of field excitation

necessary at different loads to give the required voltage. This being determined for each machine, avoidance of cross currents with either steady or variable loads can be obtained by properly exciting each machine. To regulate the division of load, or useful output, adjust the speeds so that neither machine will drag upon the other. That is, in order to even the loads, so adjust the governor of the driving source of the most lightly loaded machine that the tendency will be to slightly increase the speed.

"In an article by the writer in the March issue of the *American Electrician*, on page 84, columns 2 and 3, from paragraph 5, the above is tersely spoken of, and the difference between the running of alternators driven from the same shaft by belts, and those driven from separate sources, is discussed.

"The statement is made that alternators so arranged that their speeds cannot be separately adjusted, will not run well in parallel, and that no amount of field regulation will overcome the difference in currents."

Mr. L. B. McClellan, of Louisville, Ky., refers to a previous letter by Mr. Hall on the subject of "Commutator Troubles." He considers Mr. Hall's letter valuable to two classes of men—

"Those who electrically know very little and those who know too much; to the first it is a practical and forcible indication of the most important stimulant to armature longevity, namely, care of commutators and brushes, and to the second class is an equally forcible reminder that some sources of trouble are so commonplace that we are apt to overlook them.

"Most of the troubles inherent to dynamo electric machines, and especially to street railway motors, can claim the brushes or commutator as their origin, and here the writer wishes to add that worn commutators and the thinning of bars consequent thereto, are not the only source of the brushes losing their setting. Wherever wooden yokes are used to hold or insulate brush holders, this trouble and even worse ones can be looked for in course of time, because the heat in a closed motor will eventually shrink the wood, and either draw the brushes together or loosen the fastenings so that the brush holders themselves become shaky. The immediate result is vicious sparking, and finally the current jumps over to the motor frame.

"The reason that the current jumps is, that upon sudden increase of current the arcing, due to the loose brush leaving the commutator, vaporises the carbon and copper, and this hot vapour offers to the current an earth path of less resistance than the natural path which includes the motor's self-inductance.

"Where a series-parallel controller is used, this jumping over to frame almost invariably takes place when the controller handle passes from series to parallel, because it is at this point of sudden transition that not only is the current a maximum, but so is the inductive resistance of the motor circuit. The truth of this statement is evidenced by the fact that roads using ordinary multiple controllers or rheostats are comparatively free from 'jumping over' troubles."

Mr. E. Thomas, of Pittsburgh, Pa., gives an experience of his on the "Polarity Test of a Dynamo." Some months ago, while out on road work, he was somewhat surprised when a friend, the manager of a street railway, imparted the information that he was using a generator that always reversed its polarity when its field circuit was opened, *i.e.*, the field polarity due to residual magnetism was opposite to that existing when the dynamo generated a field current. "Mr. —— made a test in the writer's presence, and the test, as it was conducted, sustained his remarkable statement. With the field self-excited, the right hand upper pole attracted the north end of the compass needle, but upon removing the field current, the compass needle promptly swung around and presented its south end to the pole-piece. In face of the facts that the machine was an isolated one, and that the field current was in each case very gradually removed, the behaviour of the compass seemed to be inexplicable; but the explanation of the very unusual action finally resolved itself as follows: The compass was held so near the armature head that under field excitation it indicated, not the polarity of the pole-pieces itself, but that of the pole induced in the armature core by the field's magnetic lines of force. Upon removing the exciting current, the armature core, being of soft iron, retained very little residual magnetism, but the cast-iron field core and pole-piece retained enough to direct the magnet of the compass. Upon shifting the compass to a position nearer the pole-piece, the polarity of the deflection remained the same whether the field current was on or off. It must be borne in mind that the polarity of an induced pole is the reverse of that which induces it; so that the lesson to be learned from this bit of experience, is that when testing the polarity of an excited dynamo, hold the compass well over on the pole-piece side of the air gap."

THE EDUCATION OF ENGINEERS.

Commenting upon an address by Mr. John G. Kerr on educational experiments before the Philosophical Society of Glasgow, when the lecturer showed a diagram of the brain, and traced the effect of stimulus received at a low and transmitted to a lower centre, *Engineering* makes the happy remark that the most important duty of the educationalist of to-day is to teach the public the real reason for schooling. The public who, in *loco parentis*, pay the school bills, are apt to measure education by the amount of knowledge brought home by their children, much as though they were raiders bringing home so much plunder, or perhaps so many trunks to be filled with tangible information. Mere information is well enough in its way, but without the power to apply it is no more serviceable than a plane iron without its stock. Just so far as teaching only imparts instruction without the power of thinking, so far does it fall short of the higher title education.

The brain has been so far mapped out that brain lesions are located by the reactions due to judicious excitation of particular nerves. Throw one leg across the other knee, and strike the upper knee, and the foot jumps. It jumps because the stroke has been conveyed to the brain, and the brain returns the signal and makes the foot to jump. Now, says Mr. Kerr, the upper and lower brain centres are connected, and they are so connected, even in the infant, but there is no connection between the different brain centres. Therefore there can be no association of ideas and no thought. The connection is perhaps there in a limited degree, but it can be developed by use. Action determines structure is to be the motto of the teacher whose aim should be to supply the missing links between the brain centres. There are no doubt many people killed by the fall of objects upon them who, had they been quicker brained, would have associated the falling object with the idea of danger. This perceived the great idea to be worked up would be to move away, and the brain would give the muscles the signal to move. The difference of a small fraction of a second between the time element of two thinkers would mean life or death.

Mr. Kerr's address gives rise to much food for thought. To get away from danger is nature's first prompting, and the man who runs away in battle may really be a braver man than his fellow, who perceives at the same instant the disgrace which would follow. The quick apprehension of the consequences makes the timid man remain, rather than obey the first natural impulse. *Engineering* remarks that the mechanical instinct is probably the result of thousands of forgotten impressions which have established a close relationship between the parts of the brain which deal with weight, size, and motion. How often have we seen the student smile at the much abused practical man who runs his thumb along the rule, and looking at the length marked off by the, perhaps, dirty nail, says make it so and so.

Now, this very action may show that the man's brain is capable of rapidly co-relating the data given him with the length marked off by his thumb. A brain better trained would probably enable the possessor to say, "make it 2 inches. His better brain could perhaps picture the appearance presented by a piece of 2 inches than could the brain of the thumb man. Yet both men would arrive at an accurate conclusion, and, as mechanical engineers, are educated better than the student who works the thing out by higher mathematics and book data of strengths. The higher mathematics is a valuable tool, but there is sometimes a danger that the possessor of such a tool will use it wrongly.

As we write, we have in mind a man of fair attainments who seems to be absolutely incapable of any connection of ideas. His brain is like a railway built on the wheel plan. An idea can be followed along one spoke, but there is no rim to the wheel, and to reach another spoke end he has to be conducted to the hub and along each spoke separately. Thus we asked him to order two belts and fasteners for same. The two belts being of the same size were to be sent in one length, and the idea of one length of belt so dominated him that he could not order the two fasteners. He could not think out, either, why it was desirable to purchase all the belting in one length instead of in two lengths asked for by the fitter. Similarly we recently met a fitter who travelled some miles to say that some pipes were too long when he had measured the longer of two pipes, which, to his eye, looked equal, and he could not think to measure both. Nine out of ten men are incapable of clear thought, and the reason is, if we are to accept Mr. Kerr's theory, that they have never taken the trouble to connect their brain centres. But why have these non-thinkers not run their connecting lines? Can the lines be run in every brain, is a thought which suggests itself. Are there brains which have their centres incapable of such connection, or are the centres too dull of action to respond. There must still be differences of quality, and something perhaps of a still deeper hidden nature that leaves so many men content never to think at all. And it is just as often the nicest of men who fail to think.

ELECTRIC RAILWAYS—HOW TO MAKE THEM A COMMERCIAL SUCCESS.

From a paper recently read before the Canadian Electrical Association, by C. E. A. Carr, the *Street Railway Review* makes the following extracts:—

For an electric railway to be a commercial success depends not only upon the economy and efficiency of its power house, and of the roadway upon which to operate the cars, but "How to make it a success" is the query that taxes the brains of general managers and superintendents throughout the country. How to increase the receipts, without materially increasing the operating expense, are the questions the directors ask at every meeting.

A certain degree of revenue is the reward of all street railways that run cars up and down the thickly populated streets of any of our larger cities, but is it the success, commercially, it might be? There is an old story told of a toad, that stood on the bank of a brook, with its mouth wide open, waiting contentedly for flies to come his way. It seems unnecessary to say that the toad died of hunger.

The attitude of many electric railways to-day, is not unlike the unfortunate toad, and while life may be sustained months, perhaps years, death, in the form of the receiver, comes too often.

It is not enough that we carry our regular customers. These come to us anyway, and it is to these that we look for a guarantee of our operating expense. The profit or success of the railway lies in the margin of how many we can induce to become patrons, and thereby increase the regular revenue. This may be accomplished by various means. The railway company, like any other business concern, has goods to sell, in the way of rides, and no doubt there are times in the day when the manager feels that he is overstocked, and is inclined to put on "Bargain Matinees" to get a full car. He should advertise and let the people know there is an electric railway in town; that its business is to carry people from place to place comfortably and quickly, and that they can't afford to walk; that the time saved in riding will more than pay the fare. There are various ways in which to do this, and methods may be adopted so that the cost is very slight.

One very good way is to issue annually a handsomely illustrated booklet, which contains cuts of all the interesting points touched by the cars, briefly telling how to get there. The different firms supplying the company with materials will advertise for the asking, and the cost to the company is practically nil. This style of advertising is particularly valuable to strangers and tourists. The railway company in London, Ont., issued just such a little booklet as I mention, about a year ago, and it was a daily occurrence to see a group of strangers taking a ride around the Belt Line with book in hand, pointing out the various public buildings, parks and squares, as the car went along.

A specially illuminated car for trolley parties is a profitable source of revenue, and the effect of the coloured lights along the line, as the car passes, is very pleasing. It is a good way to advertise, and tends to popularise the service. Many electric railway companies establish parks at the end of one or more of their lines, and provide amusements in the way of band concerts, &c. This brings considerable increased revenue, at a time of day when cars would otherwise be running light. To what extent a railway company should provide attractions for its patrons, must depend largely upon local conditions. Some companies claim to have profited by this departure, while others have an adverse experience. It is more desirable to have the amusements provided by some one else who thoroughly understands it, the company making certain concessions in the way of issuing coupon tickets for admission. In this way, the railway runs no risk and profits *pro rata* on all increased business.

The selection of employés has more to do with the success of an electric railway than anything else. The idea that any one can run a street car, has, in many cases, resulted in the employment of incompetent, careless and ignorant men who, through these qualities, have brought the railway into public disfavour. Conductors, motormen, inspectors and shopmen have the power to earn or lose money; make the railway popular or odious with the public; keep claims for damages at a minimum or make them a burden, and very often their selection does not receive the care that is exercised in the purchase of ordinary supplies. Every employé should be considered an agent of the company, and should not only be sober and intelligent, but have good judgment and a cheerful disposition. Loyalty to the company he serves should be his first motto.

With the whole army of employés loyal, faithful and devoted to their duty, gross earnings will steadily increase and operating expenses be at a minimum, and the stockholders would no longer need to ask if the road was a success.

The growing demand of the public for better accommodation and luxury in the matter of travel and speed, must be met by giving them better cars, more comfortably furnished and more expensively fitted than heretofore. By supplying these demands the company will add largely to its revenue.

COAL.

Coal being the generally recognised fuel for the generation of steam, there are certain considerations to be taken into account in burning the same in boilers if we are to do so economically, and for this purpose it is necessary to study the quality particularly. Of course, in this connection, locality will have everything to do with the matter, but if there is a free hand, engineers will sometimes waver in their decision and buy the cheaper article, eventually settling down to one particular class, which they hold to give the best results in the way of steaming. That it does not pay to use inferior qualities may be accepted for granted. Cheapness means a greater proportion of impurity, and this in whatever form it may be present gives out no heat, but on the contrary abstracts so much from the actual combustible with which it is mixed. What would otherwise go to evaporate water is thus partly lost in raising the temperature of the waste products contained in the coal. Assuming, however, that a fair price is paid for a good article, we know that we may make our purchases from among the North Country bituminous and hard steam at the extremes to any variety between the two. Locality and fancy have a great deal to do as regards selection, the cost of carriage entering into the former consideration, and the personal equation being of as much importance as in most other engineering questions. The two classes, if we may so further summarise them, become more shortly English and Welsh, the one soft, the other hard, and the latter being known as smokeless, it is an axiom that for this desirable quality alone the cost is always

high. It does not follow that the extra amount paid is commensurate with a greater efficiency; in fact, it has been proved that smoke may be in the proper place. Owing to its greater conductive power, a very good means of disseminating heat. Still, apart from the property of smokelessness which it possesses, Welsh coal contains chemically, on an average, nearly 90 per cent. of carbon, either free or associated with hydrogen in some form, and this is about one-tenth more than is found in English. As a set-off against this excess, however, the latter kind is, as a rule, richer in hydrocarbons, leaving a less balance in favour of the Welsh in the way of total heat units than might be anticipated; in fact, bringing possibly two assortments of ordinary Welsh and good English quite into line as regards heating powers. This is neglecting what other constituents there may be, as the thermal units given out by any of them are of lesser degree, or no value at all. It is needless to say we are only taking two average samples of each kind for comparison, and that there is a considerable range in point of numbers and values of the component parts furnished by them. If we endeavour to classify still more closely the various coals found on the market, we may include Scotch cannel and the semi-bituminous classes coming from other parts of England; but we find from analysis that there is no great difference in the potential heat contained in a fair specimen of any of them. It is in the main solely a question of the quantity of carbon and hydrogen. For instance, Scotch coal is, as a rule, rich in the latter element, but being poor in the former, the gain in one makes up for the loss in the other. The chemist can always tell us the truth of the matter as far as the relative values of each is concerned; but, by a process of a survival of the fittest, we pay for the quality that gives us proportionate results without much reference to the laboratory. Whatever supply is nearest has, as a rule, the first chance with the consumer; and if any detrimental action takes place from its use it is common to purchase a smaller quantity of another class and mix the two in the endeavour to advantage the boiler and the general establishment charges. There may, for example, be a large proportion of water present in the cheaper supply, requiring an extra amount of fuel to get rid of it by evaporation. If now we can add some dry burning coal either of the hard steam or bituminous kind, the latter containing plenty of rich smoky gas, we may do so with the most beneficial results. Resort has been had when only very low qualities of breeze were to be obtained, as was the case in the great strike, to use it with a little Welsh, and the latter being in the form of lumps has the desired effect of livening and keeping up a bright fire without extraneous aid of any sort. Where a fuel contains a large proportion of ash, reducing the amount of combustible per ton and clogging up the fire with the consequent promotion of evils that are well known, the same process may be followed again. There is no absolute rule that can be laid down for guidance because the plant itself has so much to do with the combustion going on. We ought theoretically to obtain all the heat there is in the coal for the purpose to which we put it, but in practice this is seldom or never the case. The conditions of working may be totally at fault and prevent the utmost being got out of the fuel. Apart from alterations in the plant itself it is often found that a change in the coal used may be of the greatest benefit. While hard steam does admirably on one boiler, a soft bituminous may be most suitable with another. It is generally a matter of trial, the production of a full flaming gas during combustion just suiting one case, whereas the heat peculiarly characteristic of a Welsh coal is better adapted for another. Therefore while chemistry is useful in a way and in certain circumstances may be our only help as regards the quality of doubtful coal, yet on the whole users trust to general sources of knowledge to help them to find out what they should burn.

Welsh coal is supposed to be smokeless though it not unfrequently belies its name in this respect, and without the very best is bought, may not always pass inspection much more than other varieties. Being generally harder and of a dusty nature, its heat is diffused in the way of a deep glare in the furnace. Containing more carbon, the combustion is more completely local to where it takes place on the grate bars, and as there is little flame, the plates are always kept clean. The intense heat generated has full play directly in the furnace where it is wanted, any smoke that does issue from the stack being of a duller kind, and generally capable of being seen through. The quantity of ash remaining is about the same, whatever the coal, that from Welsh presenting the caky appearance that would be expected from its original unyielding form. When we turn to Newcastle kinds, we find heat takes hold of them more easily, the gases contained tending to bring about dissolution very readily. Flame is abundant, and the difficulty is to retain it in the furnace, and prevent some of the products of combustion becoming lost beyond the confines of the boiler, and thus escaping in the form of smoke. Some designs and settings of boilers are so arranged that there is very little danger from this source; but there is always the greater tendency to it where the coal is soft, and therefore more readily broken up into its elements. It is evident that in this case, although the quality may be all that can be desired, yet greater care is necessary in the conditions of the plant for burning it, if we are to obtain corresponding efficiency to that from Welsh. It is not that the bituminous coal may not be actually as good as the other; it is rather the difficulty of using it economically that presents itself, and this same remark applies in perhaps a greater degree to Scotch coal. It is possible for any particular boiler to give a higher duty by substituting an inferior quality for the extra price due, or to a lower grade fuel to add a certain proportion which is superior, whether this is of the same or another class altogether. Generally, as we have said, it pays best not to stint the expenditure for obvious reasons, but if the plant remains unalterable, or has drawbacks of its own fatal to good economy, there is no other course open to users but to endeavour with the numerous opportunities that present themselves for varying the quality, to make up for the defects in the boiler and its surroundings by experimenting till they find out in the way suggested what is the most suitable coal to burn.

AUTOMATIC BLOCK SIGNALLING.

Mr. Archibald C. T. Bond has sent us for review a copy of a specification which has been granted to him for automatically signalling between signal cabins and moving trains. Mr. Bond proposes to lay down in the near neighbourhood of the signals which are placed upon the line for the purpose of guiding the engine driver in the movement of his train, three contact rails, subsidiary to, and between, those which form the railroad track; and to connect the two outer of these contact rails by wires to contact points—the one outer rail to, say, the "on" position of the signal lever operating the signal in question, and the other outer rail to the "off" position of the same lever; the intermediate rail being connected to a battery the opposite pole of which is so connected as to be common to both positions of the signal lever. Thus, assuming the contact rails are, by any available means, connected, on the signal lever being placed in either the "on" or the "off" position, a current will traverse whichever of the two wires are joined by the action of the lever, but during the time the lever is neither fully "on" nor fully "off," so far as the movement of the lever will admit, the contact points are broken and no current should flow.

On each locomotive engine he places two bells, of different note, so that the one may be distinguished from the other—one on either side of the locomotive cab. These are joined up so that one is intermediate between a contact maker traversing each outer rail and a contact maker traversing the centre rail, which is common to both.

We have thus two circuits—one operating one of the bells when the signal lever is in the "on" or "danger" position, and one when it is in the "off" or "clear" position—each of which is dependent upon the action of the signalman in the manipulation of the signal lever in question.

By this arrangement Mr. Bond proposes to communicate to the driver of a passing train, whether he is entitled to go on or whether he is required to stop. Mr. Bond, in his specification, shows two means of effecting this; but we, in thus referring to it, have selected that means which is evidently the most simple and economical, and that which, should it ever be adopted, would no doubt be followed.

We have, in dealing with this question of automatic signalling between signal cabins and moving trains, on pre-

vious occasions pointed out the objection which those responsible for the conduct of railway traffic in this country entertain to the employment of that which is in any way calculated to reduce that individual responsibility which it is thought should attach to every action of those whose duty it is to regulate the traffic by means of the block signals.

We recognise that Mr. Bond's idea, like that of so many others, is to provide something which may take the place of the "fog-signalling," which now calls for the presence of so many men in most objectionable weather, and at, as a rule, most objectionable hours, and we quite sympathise with him and others who have laboured to the same end; and, moreover, we are aware that none would more readily welcome a reliable means, one which would command the approval of the Board of Trade, as well as the confidence of the companies officers, than railway managers themselves.

The cost of "fog-signalling" forms a considerable item in the year's expenses of every railway, but it is clear that any system which professes to accomplish a remission of this expenditure, must be one on which perfect reliance can be placed. We doubt if electrical apparatus of such a character as to be operated by a primary battery current can be so constructed as to withstand the violent treatment it is bound to experience on a locomotive engine. Sooner or later it will succumb. Failure may arise at an inopportune moment. Mr. Bond tries to meet this by giving the driver two signals—one to tell him if his road is right, the other to tell him if it is wrong—but there might arise an occasion when, with a fog too thick to admit of the driver seeing his signals, there might also be a failure of the bell, or of the battery, or of one of the several points of contact which the current has to traverse, and in this instance no signal is a good signal and the train passes on! These are points which would naturally present themselves to a railway company's expert, and are mentioned here, not so much in reference to Mr. Bond's proposals, as in relation to the question in general. All who take an interest in railway signalling will be aware of the multitude of inventions which have sprang from the desire of individuals to meet this evident want; yet, so far, without success. It would perhaps save trouble, and in many instances disappointment, if before giving effect to ideas the Patent Office records of a subject which has occupied the brains of so many were examined. Those records would not only tell the explorer what had been done and what might therefore be regarded as untenable, but in doing so might direct him to a channel which might in the end prove practicable.

REVIEWS.

The Localisation of Faults in Electric Light Mains. By F. C. Raphael. London: *Electrician* Printing and Publishing Company, Limited.

In the preface to this book the author says: "Central station engineers would do well to study the chapter on 'Fault Signalling Networks.'" He might, we think, have gone further, and have said that they would do well to study this book from beginning to end, as the whole subject of the testing of mains, and the localisation of faults, is one that, in our opinion, has been much neglected. We have often been struck by the contrast between the care bestowed on the station plant to avoid a breakdown, and the small amount of attention that is given to the mains; and yet in the station there is reserve plant ready to be put in service in place of any machinery that may get out of order; there are spare boilers to allow of each boiler in turn being shut down for a general overhaul and repair, and duplicate or ring steam mains, so that the service may not be interrupted by the blowing of a joint or other mishap; whilst outside all is changed, and we rarely find reserve mains or any arrangement that will allow of a main being temporarily put out of service without interrupting the supply. Under such conditions it would be natural to suppose that very special attention would be paid to the maintenance of the mains, and to the discovery and repair of faults before they get bad enough to cause a breakdown; but this is somewhat exceptional, and in many cases we believe it is no exaggeration to say that the cables are buried out of sight, and being out of sight, are left to take care of themselves until a breakdown occurs.

We think that this is in great measure due to the fact that so many station engineers, having served their apprenticeship with engineers and dynamo builders to fit themselves for taking charge of the generating plant, have had no opportunity of gaining practical experience of cable work, and that there has been no text-book dealing with the subject of testing electric light and power mains; so that the book before us should be a very welcome addition to the library of all engineers who have a system of mains under their supervision, and wish to become conversant with the methods of testing and localising faults which can be used under different circumstances.

The author commences with an introductory chapter, in which the theory of the Wheatstone bridge is explained, and various forms of bridge resistance boxes and slide wire bridges are described. We notice, however, that no mention is made of the dial form of resistance box, although it is a very convenient one and is largely used. The method of measuring high resistances by direct deflection is then explained, and this is followed by descriptions of portable testing sets, galvanometers, and accessories, and by some very useful hints concerning the choice of a galvanometer suitable for the special work which will have to be done with it.

The second and third chapters deal with the testing during working of low and high pressure mains, and show how much easier it is to make these tests on low pressure continuous current mains with separate insulated conductors, none of which are earthed, than when other systems are used. For the former a choice of four methods is given, of which the first is by earthing each conductor in turn through a voltmeter or ammeter. It is said that this method is the oldest, and that it was introduced and first described by Herr Frisch in May, 1889; but if we are to take this as the date of its birth, its claim to be the oldest method cannot be maintained, as at a meeting of the Institution of Electrical Engineers in February of the same year, Dr. John Hopkinson described his bridge method of measuring the insulation resistance of a two-wire system.

The second and third methods in which one conductor only is earthed through a voltmeter or galvanometer, and readings are taken first with the instrument unshunted, and then shunted with a known resistance, are not so well known as the first; but we agree with the author that they are generally to be preferred to it, and from personal experience can recommend the second as a very convenient method. The fourth is a bridge method, which, however, is more complicated and requires more elaborate apparatus, and is not, therefore, likely to find very general favour. All four methods are fully discussed, and in a separate chapter later on the proofs of the formulæ for the first three methods are given, but that for the bridge method is omitted.

Low pressure alternating current networks are dismissed in a few lines with the remark that the above methods are not suitable; but, although this is true when concentric mains are used, we think an exception should have been made in favour of mains composed of separately insulated conductors, as the effect of capacity on the potential difference to earth is small in this latter case. Generally speaking, the special conditions obtaining when concentric cables are used, and the difficulty of testing them during working are not dealt with; and it would have been well to have laid more stress on this point, as although this disadvantage may be counterbalanced by other considerations when alternating currents are used, we cannot see any reason for using a system which makes testing so difficult on continuous current networks.

Similar difficulties are met with in permanently earthed networks, and the author recommends in this case the use of fault signalling apparatus, such as is described in a later chapter. It is shown that whilst it is impossible to make any test if one main is earthed throughout its length, yet an indication of the state of the mains can be obtained in cases where one main is earthed through an ammeter at the station or at feeding centres, and is insulated from earth at all other parts of the network; and that the fault resistance can be accurately measured if it is allowable to temporarily increase the resistance of the earth connection during the test.

Passing on to high pressure mains, the author shows how some of the tests already described can be applied, though not so conveniently as with low pressures, and also mentions the vacuum tube test for alternating current mains.

We next come to a chapter on fault localising, when the faulty cable can be disconnected from the network, with descriptions of Murray's and Varley's loop tests, of fall of potential methods, and of the overlap and Blavier's methods for very low resistance faults. Examples are given to explain how the tests are made, and how the position of the fault is calculated, and the best ways of arranging loops under various conditions are discussed. We cannot, however, agree with the author when he says that the connecting leads must be considered as part of the loop, as we think it is always safer, with the low resistance loops which are met with in lighting mains, to run separate leads for the bridge and galvanometer, and to allow for the bridge leads as part of the bridge resistance, which can generally be made high enough to render any slight error in the resistance of the leads of no importance. A method of breaking down a fault, of which the resistance is too high, is given, and the chapter concludes with some remarks on the maximum fault resistance, for which it is possible to localise by the methods described, and on the errors caused by the existence of minor faults or general leakage in the cable.

Chapter V. describes methods of localising during working, commencing with the induction method, in which the better insulated conductor is put to earth through a contact breaker, whilst a coil with a telephone in circuit is carried along over the faulty main until the telephone ceases to sound. This is the ideal method of localising, as it is not necessary even to open a street box until after the position of the fault is found; but there appears to be considerable doubt as to its reliability, and it would be very interesting if engineers who have used it would publish their experiences. We may mention here an oversight which may lead to some confusion, which is that the reference numbers of the diagrams in this chapter, from 68 to 77, have already been used for another set of diagrams. The methods of applying loop tests during working, which are next described, are somewhat elaborate, and require a good deal of experience to carry them out without damaging the apparatus; but they are well worth studying, as one of the greatest difficulties in the way of thorough testing is the objection of managers to the cutting off of the current even for a short time. Of course gas and water users are accustomed to having their supply cut off temporarily every now and then; but users of electricity do not yet seem to have attained such a philosophic state of mind, and, we suppose, send in complaints which the managers of the younger industry do not care to provoke.

Chapter VI. treats of fault signalling networks, by which name the author designates the systems of test wires laid up in the main cables and connected to indicators in the station, such as are in use in Berlin. The weak points of these systems is, that they do not go far enough; as it is practically impossible to arrange for a sufficient number of sections of the network, each with its own indicators, to make it possible to dispense with other means of localising, and what is, perhaps, more important, the faults are not signalled until of very low resistance. However, as the author points out, they are the only methods of testing some classes of mains which are possible during working, and they would undoubtedly be of service in such cases by indicating the section of the network which is faulty, and so limiting the area in which the fault is to be looked for.

In the next and last chapter are collected the proofs of a number of the formulæ which have been used in earlier parts of the book, and then come two appendices, the first being a reprint from the *Electrician*, describing a modification of the slide wire bridge, devised by the author so as to make it a direct reading fault localiser when used for the loop test, and the second a table of legal standard gauge wires, which is, however, called in the heading the London Standard Wire Gauge.

This book is well written and printed, and the author is to be congratulated on having produced a very useful treatise on testing as applied to lighting or power mains; but since it is likely to be often used as a book of reference, a fuller and more complete index than that given would be a great improvement.

THE TRAINING OF AN ELECTRICAL ENGINEER.

[COMMUNICATED.]

"Train up a child in the way he should go" is a biblical adage which—though no doubt intended by the sage to refer to moral and physical education, assisted, perhaps, by corporal correction—may be considered to apply equally well to that higher education which is supposed to prepare every youth for the special branch of life to which he dedicates himself, and in which he hopes to earn his livelihood and make his mark.

In these days of competition from within and from without—of big supply and smaller demand, of English markets open to all the world, and the world's markets difficult to English goods—the struggle for situations has become so keen, that only a comparative few who have exceptional aptitude, exceptional training, and, very often, exceptional influence, come to the fore. The rest remain average men in a groove, along which they travel to the end, with their pluck taken out of them by repeated and vain efforts to pick up, now, what they failed to learn when young—or, disgusted with this retrospect, turn to another career.

In no class is this more marked than in that of the electrical engineer. It is not hereby intended to argue against the theory of the survival of the fittest, for the brainless and idle always go to the wall; but it is questionable whether if the number of fit men were greater, and if the general average were fitter, the effect would not be to generally improve this, or any, particular profession in the country; to increase the trade connected therewith, to create thereby more vacancies and higher salaries, and also to cause a greater demand for English experts in other parts of the world.

To revert to the biblical adage: if a child is brought up incorrectly, or left to shift for itself, the chances are that unless it has a character of special determination it will develop into a morally unfit and degenerate adult. The rest of the world will see that this person is not up to the social average and draw their own conclusions as to the cause—more or less correctly. The man himself will, however, in his better moments, see and acknowledge the true cause of his failing—his want of proper training when young. And so, by analogy and actuality, the electrical engineer is the only man who can really judge as to whether the training he received for his profession was beneficial and efficient for his future—or not. He, and not the professor who arranges the syllabus, knows as a student what his attainments and capabilities are, although he may not be able to voice them; and he only can see, after a year or two of struggling, where the system was found wanting. There are so many men who, with perhaps a practical leaning, drift by reason of their training into a physical laboratory and remain demonstrators to the end of their lives; or others with a theoretical bent, who, by reason of a bad syllabus or course, think they are practical men, and after wiring a few houses make the acquaintance of the Bankruptcy Court. And there are yet others who, at the end of their first year at college, might be advised by a conscientious professor to adopt another career altogether.

The question, therefore, arises, as to whether the technical education now obtaining is of the best kind for turning out electrical engineers (for we will leave the training of theoreticians to other authorities); whether we have not been on the wrong tack for some years, and whether some other ideas cannot be put forward for the consideration of those in authority, so as to obtain better results. The fundamental idea that a man who has spent all his life in teaching, thinking and reasoning, is the proper person to entirely educate youths for any special practical profession, is mischievous; no censure is hereby intended for those professors who have concientiously carried out their duty at the technical colleges, or for the societies who have so generously founded these institutions. There is, however, room for improvement in the constitution of the committees which govern them; these bodies should contain a few up-to-date practical men; not merely men who have been brought up in an engineer's office, but men who have—or have had—charge of

works themselves. Such a governing body would then be more suited to keep an eye on that branch of the institutions which should be more specially suited to turn out practical men.

The chief difficulty which young fellows leaving college experience is to get a situation in works with a salary befitting their age, and the reason of this difficulty is that the firms have a very poor opinion of a man coming straight from college; he has absolutely no commercial knowledge, no idea of estimating or of book-keeping, of managing men, of testing dynamos and engines in a commercial way, and of a thousand and one other things. They must then either become pupils—which is generally a clear waste of time—or else start on a pittance of about 20s. per week. This is, of course, perfectly fair from the firm's point of view, and only to be expected. Others again may have some money of their own (or of their friends), and set themselves up as wiring contractors and importers of small accessories from the Fatherland, which they sell at starvation prices. These having also no knowledge of estimating, financing, or the ways of the British workman—enter into contracts which do not pay them—and fail. How then can some of these consequences of a faulty system be averted or improved? To turn a technical college into a Works, and let it pay its way, is as impossible as converting a Works into a home for pupils, and expecting it to pay dividends—although this is sometimes attempted. Besides, the trade would be up in arms, under Colonel Howard Vincent, to protest against the selling of college made goods; evidently, then, such things could not be. How, then, is it possible to give the student a more practical education so as to fit him to take a more creditable position when his course is finished, or to be in a better position to start business for himself than he is at present? Is it possible that he is crammed with theory and without the knowledge of applying it? It is more than probable that this is the truth.

With the student's first year we have little to grumble at. He must be grounded in elementary theory of all the sciences, and thoroughly grounded; it is only after a year of such work that he, or his teachers, should be able to judge whether he is practically or theoretically inclined. Certainly every teacher who takes any interest in his pupils should be able to observe this, but an examination would decide the point, and also make it clear whether he should not go through this year's course again, or adopt another career.

After the first year there should be two courses open to the physical student, (1) the engineering or practical side, and (2) the professorial or theoretical side. Those who enter either should do so with their eyes open, and with the advice of the Body of Examiners. It is only with the practical side that we will deal, and it must be understood that our contention is not for the absolute effacement of theory by any means, but for the *practical demonstration of all theories necessary for a commercial career*, for the proper instruction in the ways of business, and for the abolition of excessive theoretical education and what is known as "Original Research." If a man is fond of theory, he will read in his leisure moments; if he is of an inventive turn of mind, it will come out sooner or later; but it is ridiculous to waste days—nay, weeks—of his third year in alternately attending lectures on higher mathematics and spot chasing in a laboratory, especially when the original idea is the professor's, and not his own.

The necessary main subjects for an electrical engineer's education are:—

Physics.
Mathematics.
Mechanics.
Chemistry.
Drawing.
Commercial engineering.

When the student enters upon his course he is supposed to have a smattering of all these subjects—except the last. This is, however, usually only the result of cramming for the entrance examinations, as such subjects are not systematically taught at school—barring, perhaps, mathematics. We will now analyse each of these subjects in turn, with the object of pointing out what may most profitably be amended or ended.

Physics.—This subject embraces a very wide field, but for the electrical engineer optics, electricity, and magnetism may be said to be the necessaries. With optics he need not go very far, except, perhaps, in the practical testing of candle-powers of arc and incandescent lamps, the different photometers employed, and the methods used by makers of lamps. There is then the question of the diffusion of light, lenses, prisms, polarisation, &c.; but these things need only be touched. With electricity and magnetism, however, there must be as much grounding in the elementary principles as with the three R's. The student does not need to be troubled with too much history; he can read that at home; he also does not want to waste hours in the lecture room and laboratory learning about positive and negative charges on spheres, or playing with the catskin and electrophorus. Neither does he want to be bothered and confused by long dissertations on the theory and construction of galvanometers, or the behaviour of little cavities cut in electromagnets. What he requires is to know how to measure every permutation of Ohm's law connected with telegraphy, lighting, dynamos, &c.; to get a thorough knowledge of the Wheatstone bridge and every form of measuring instrument used in practice; to test dynamos, arc lamps, batteries, &c.; to have an efficient instruction in dynamo design, &c., and to keep these things up from time to time during his course. The teaching of dynamo design, together with that of transformers and alternating machinery—such as it is—is usually absolutely useless as given at colleges, and when a man comes to apply this information at works, he finds that the commercial design of a dynamo is different to the professorial method.

Mathematics.—A fresh student is generally supposed to be well up in Euclid, and to know something of algebra, trigonometry and geometry. His first year may be profitably employed in perfecting himself in these things, and in getting a grounding in conic sections and the calculus. He then can roam into the higher branches of conic sections, and perfect himself in the elements of determinents, vectors and the calculus. His training need not go further than this, and if he knows these things well, he knows all that he is ever likely to require. The professor should teach those mathematics by consultation with the physical professor, which the student would find most useful in his particular branch; but to soar into the heights of harmonic functions and elliptical integrals, simply because the professor finds them "sublime," as is frequently done, is mere waste of time.

Mechanics.—The first year of this subject may be profitably employed in giving the student a thorough knowledge of forces, of mass, weight, impact, &c., with experiments, as is usually done; he may also attend lectures on strength of beams and girders. But after his first year the study of the steam engine should be taken up thoroughly, together with hydraulics. These things are most important for an electrical engineer, and are systematically neglected at colleges. There should be steam engines for testing purposes, both open and enclosed, and exhaustive experiments should be made with steam consumption, efficiencies, &c. Boilers, feed-water heaters, fuel economisers, and all the paraphernalia of a central station, should be thoroughly studied and grasped.

Chemistry.—The student wastes a lot of time on useless branches of this science. He does not want to study quantitative analysis—waiting hours for the use of a balance. Let him learn qualitative analysis thoroughly, and in his second year go through a thorough course of metallurgy, especially applied to extracting of ores by electricity, construction of accumulators, plating, &c.

Drawing.—As much time is spent on this sometimes as if every student were to become a qualified draughtsman. He does not want to know how to draw a railway bridge, or how to bond bricks, but to get a proper idea of drawing machinery in section and otherwise, of drawing from the model and from memory; copying from the board is waste of time.

Commercial Engineering.—This branch need not be taken up until the course of three years is half gone; it should comprise estimating in every form, book-keeping, balancing books, invoicing, works' costs, languages; also testing of combined plants, erection of machinery, wiring, &c.

As these things are all more or less new, we may be excused for dealing with them more in detail.

E

The estimating should include designing and estimating from first cost of dynamos, transformers, switchboards, resistances, house lighting, transmission of power, town lighting, and central stations.

Languages should include French and German, but merely of the technical and commercial style; translating of papers, letters, &c., and reading of technical journals.

It may now be asked how all these things are to be instructed; we will deal with the theoretical first. It is, of course, certain that many firms would not allow their staff to give lessons in such things. There are, however, others who would not object if the work did not interfere with the teacher's business; there are, besides, many consulting engineers in a small way who have not too many contracts in hand; these would gladly accept a lectureship, of, say, 4 to 6 hours a week to instruct in estimating, &c.; these sort of men have all been in works, and have the practical knowledge necessary. For book-keeping and invoicing no difficulty would be experienced in finding a suitable instructor for four hours a week, nor yet for French and German; the importance of these languages is ever growing, and students should at least be able to understand any letters likely to be addressed to them as men of business. It would also not be difficult to get the services of a central station engineer for two hours a week to lecture on the running of central stations and keeping of works costs.

Our suggestions for the practical work may not meet with approval at first, but they are, perhaps, worthy of being considered. Let a portion of the student's third year fees be set aside for outside expenses, and a contract be made with, say, a firm of engine builders, of dynamo builders, and a wiring firm, for the attendance of a certain number of students, not more than half a dozen at a time, say once a week at different tests. Certain conditions for fees, attendance, and so on, would be mutually arranged to more than compensate these firms for any time lost or experience given away; but such a visit once a week to see a combined plant or boiler tested, or many other things which could be suggested, would be invaluable to the student. He might spend a few hours every week in a central station by arrangement with the corporation or company; or again, he could gain some experience in seeing derricks and scaffolding built up.

As regards wiring, he might spend a few hours a week on an installation, observing the work, lending a hand where necessary, and seeing how to manage workmen. This may all seem rather unconventional, but there are plenty of firms who would agree to it, and it would make much better engineers of the men who are otherwise engaged in experiments and mathematics which they will never apply in after life. It may also be argued that all knowledge is useful, and anything taught may subsequently prove of service. But to that we may reply that there is not time to perfect the student's knowledge of these many things, that a little knowledge is always dangerous, and that he had much better be grounded in what he does want, than in what he does not want.

It is not our province to get out a syllabus, and therefore many things may have been omitted which are still necessary, and others may have been touched on too lightly. We have, however, said enough to show what may be done, and we may leave others more competent to deal with such subjects to enlarge on the suggestions here thrown out, in the hope that something may be done to improve the practical branch of technical education throughout the country. Nobody who has gone through a course at our technical colleges, but can look back on piles of note books filled with subjects he has afterwards never touched or even thought about; hours of weary spot chasing and original research which might have been more profitably employed, and, shall we say, one year in the three spent in holidays—a quite unnecessary interval.

Then let some of these look back on the time they have further spent as pupils, or small men, in Works, till they have really had quite a fresh education, and only then can think about getting a respectable salary—and we think they will acknowledge that if some of the hints herein thrown out were to be adopted and a radical alteration made in the college syllabus on these lines, the future generation of electrical engineers would be more fitted to warrant their title than the present one.

STREET LIGHTING.

Mr. Boot's paper on "Public Street Lighting" is one of three upon the subject read before the Municipal Electrical Association. In dealing with the matter from the public's point of view, he probably expresses the experience of nearly all municipal engineers, that the ratepayers expect much better lighting at an equal or less sum than that previously paid for an inferior light. Needless to say, his endeavours to meet these requirements have not met with the success they deserve, and the sooner the public are educated to the fact that a superior light (at any rate for some time to come) will cost more money, and that the efficient lighting of the streets is a necessity, the better.

The author deals with four systems of lighting by means of arc lamps, viz :—

(*a*) Separate plant.
(*b*) Motor generators.
(*c*) Rectifiers.
(*d*) Alternating lamps.

We agree with him that the first system will probably soon become obsolete.

As regards the second he has little to say, but when we arrive at the third system, we find that "he opens himself out" with an eulogy upon rectifiers, and dogmatically states that "this is far and away the best method, &c.," and proceeds to give reasons.

We have been under the impression hitherto, that the object in rectifying an alternating current was to change it to a direct current, but Mr. Boot's first reason for deciding in favour of rectifiers is that "the arc lamps require no more energy than a *direct current lamp*." His second reason, that "they give a higher candle-power," cannot be accepted any more than can his statement that his rectifiers "have not cost 1d. since they were put down." Does he run his rectifiers without brushes, and do the commutators never require grinding or renewing?

In giving the disadvantages of the system, he admits a *certain* (!) liability of the motors running out of step and causing the commutators to "flash over," but he does not state that this means extinction of the light until the motors can again be synchronised. In dealing with the fourth system, viz., alternating current lamps, he refers only to lamps supplied from the private supply cables, and both the capital cost and cost of supply is shown in the tables following to work out in favour of alternating current lamps.

Under the heading, "Method of Control," the author deals with arc lamps in series, and refers to the advantage of being able to switch on and off at the works, while one of the disadvantages mentioned is, "handling the lamp when alive is dangerous." Why do so, when he provides isolating switches?

Referring to the latter part of the paper, in which street lighting by means of incandescent lamps is considered, the author's experience coincides with that of other engineers that it can, on a large scale, successfully compete with gas light for light. The addition of reflectors mentioned by the author, and which have been in use for some time at Brighton, is practically essential if satisfaction is to be given to the public, who judge largely by appearance. A spreading gas flame always appears to give more light than an incandescent electric lamp of the same candle-power.

The paper by Mr. Taite (Southport) treats solely of street lighting by means of rectifiers, and compares this system with that of separate plant, including Brush or Thomson-Houston dynamos. Curiously enough no attempt is made, either by Mr. Taite or Mr. Boot, to compare the relative advantages and disadvantages of rectified and alternating lamps, each supplied from special mains. The efficiency of *93 per cent.* at full load given by the author is too high to be readily accepted; but when the method of testing is considered, we should not have been surprised if it had been higher! Needless to say, the efficiency given is by no means borne out by tests made in other places, and with instruments other than the ammeters mentioned.

The third paper is by Mr. Fedden (Edinburgh), whose experience with six rectifiers appears somewhat different to that of the engineers of Tunbridge Wells and Southport.

After stating "that they are very tricky," he goes on to describe their tricks, and winds up by suggesting "as a

means of getting over this difficulty, *a continuous current motor alternator with a rectifying commutator attached for each circuit!*"

Mr. Fedden must have had a bad time to be driven to suggest this combination as a means of getting over the trickiness of rectifiers. But why not an *alternating motor and continuous current dynamo?* If motor generators are to be considered it seems absurd to generate an alternating current and then rectify it. The system of alternating current street lighting as adopted in Hastings and Newport is ignored by the writers of all three papers, although there is much to be said in its favour, and except for the cost of mains which would vary in different districts, it possesses but few disadvantages.

As continuity of the supply is of the first importance we quite agree with the author when he says that "an efficiency of only 60 per cent. and constant light is far preferable to 80 per cent. efficiency and constant and vexatious interruptions in the light." We would add that even 98 per cent. would not compensate for frequent extinction.

Mr. Fedden believes in street lighting and plenty of it, and evidently his Chief is of the same opinion with 469 arc lamps now running and 150 more being erected.

After stating the now well-known advantages to the station, he mentions that street lighting in Edinburgh "has most decidedly reduced crime" in densely populated districts. He also says that it acts as an advertisement and brings customers, and this is without doubt the experience of most engineers who have adopted arc lamps for street lighting. His paper concludes with the Edinburgh station curves for the past two years.

Taking the three papers together, there are very few facts given that are new, and therefore very little to assist other municipal engineers, while some of the statements made are, to say the least, somewhat wild and ill-considered.

LEICESTER AND THE ELECTRIC LIGHT.

Whatever may be said to the contrary, and there have been a good many conflicting statements made during the past few days, it is clear that the Leicester Corporation have, up to the present, done very little to ensure the success of their electric lighting enterprise. It will be remembered that two or three weeks ago we referred to the proposed introduction of foreign machinery into the Leicester works, and in presenting the report of the Electric Lighting Committee, the chairman, Mr. Alderman Lennard, endeavours to explain the reasons that have led them to take such a course. The explanations offered, however, are inclined to be a little involved, and slightly contradictory.

Before referring to the matter of the plant, it is well to take into account Mr. Lennard's admissions on the manner in which they have treated the electric light undertaking. He says: "The committee, however, were anxious to see the full effect which the introduction of the electric light would have upon the gas department, and they had now come to the conclusion that there was a field in Leicester both for the electric light and the gas." It has taken the Leicester Corporation 3½ years to arrive at this decision, and we may draw the inference from Mr. Lennard's remarks that if there had been an indication of interference with the gas undertaking electric lighting would have been simply strangled. Whether the Electric Lighting Committee, after spending £40,000 on plant, have been justified in their attitude of *laissez faire* is a matter to which the ratepayers of Leicester should address themselves. Coming now to the question of the foreign plant we understand that the facts are as follows. When the Brush Electrical Engineering Company secured the contract vertical high speed engines suited to the requirements of the alternators were specified, but Mr. Colson would have nothing but slow speed horizontals, much in excess of the power necessary. There was only one trouble, the alternators occasionally broke out of parallel, the cause being credited to the too powerful engines which the alternators could not control. However, they were worked separately all winter, and when in the spring the question of enlarging the plant was mooted a way was seen out of the difficulty. The Brush Company was commissioned to put in inductor alternators of 350 kw. capacity, and as the company was not able to supply machines, such as we described in our issue of September 25th, 1896, of this size by the date required, nor desirous of making Leicester an experimental station for their first big inductor alternators, the only course open was to purchase elsewhere, and as Ganz & Co. had manufactured many such machines and guaranteed parallel running, it was resolved to instal Ganz apparatus.

Arrangements, however, were at the same time made that no more of these machines were to be brought in here, so the whole matter, as will be seen, is one of the simplest nature and readily explained.

Had there been any home manufactures of the type which it was decided to employ, there would have been no need to go abroad; as it was, the Brush Company being the victim of circumstances, adopted the only possible method of getting out of the difficulty, and there the matter probably ends as far as the contractors are concerned; but, unfortunately, Mr. Alderman Lennard did not confine himself to such a simple statement as the foregoing; had he done so, perhaps one could not have urged much objection.

For some reason or other he contends that the Committee "were performing a national duty in doing what they were, for in bringing such a machine into the country it could not fail but to act as a technical instructor for our own engineers and electricians." Apart from the fact that the Leicester Corporation have no business to be performing national duties, it is presumption on Mr. Lennard's part to think that he and his Committee are going to provide instruction for English electricians on the subject of inductor alternators. Without the introduction of inductor alternators, the Electric Lighting Committee of Leicester have already provided sufficient object lessons for English electrical engineers, and they might have remained satisfied with their past achievements. Summing up the whole matter, it is clear that in the design of the Leicester works some very grave errors must have been made; in Mr. Lennard's own words, "there was a miscalculation as to the amount of flywheel power to produce parallel running," and no doubt the Electric Lighting Committee have full knowledge of the origination of the errors.

CORRESPONDENCE.

"Induction through Sea-Water."

In your issue of July 2nd there is a letter by Mr. Finlay under the above heading. I should very much like to ask Mr. Finlay, through your paper, what advantage he claims for his suggestion, as I am wholly at a loss to see how it can be of any practical value.

He says that "A is an electric bell, which can be rung from the shore, and it is situated near the end of the mooring chain."

If I am not greatly mistaken, a mooring chain of a light-ship would not be more than, say, 100 yards long, and the light-ship, in all probability, two miles or more from the shore; therefore the cable required to ring the bell, in this case, would have to be two miles, all but the comparatively short piece of mooring chain, why not have a few more useful yards and connect direct to light-ship?

Secondly, supposing the bell to be rung from shore, and heard by the light-ship man (who, I presume, must always have his ear to the ear-piece of funnel B, or how is he to know when they wish to signal from shore), how is he to know what the ringing of the bell means; has he to count the number of times the hammer strikes the gong, and thereby know it means a certain letter, word, or sentence? I think any man who could do this worthy of a better post.

Lastly, how is the light-ship man to signal to the shore? Has he to shout down funnel B in hopes of what?

F. R. G.

The Generation of Steam.

I should like to point out that the temperature of the exit gases in the Babcock boiler, mentioned in my recent paper, should have been 350°, and not 250°. It is a very obvious printer's error, as was "from and at 112° F.," in the second page of the paper, about which I am surprised you have

made no comment. Let me say that far from there being any uncertainty about the figures, they were taken by myself in both the Lancashire & Babcock results, and compared with tests taken by other engineers.

I should also like to say that by far the greater part of the paper is taken from my own experience with boilers which have been under my control, and I fail to see where I "accept as gospel much of the pabulum, &c." My paper was not compiled from books of reference.

John F. C. Snell.

July 6th, 1897.

[We refer to this letter in our "Notes" columns.—Eds. Elec. Rev.]

Dynamos.

I have read with much interest Mr. Mordey's paper on "Dynamos," and regret that I was not present at the meeting. From the report in your journal, which I presume is an abstract, I do not quite gather whether Mr. Mordey regards his special brushes as a novelty, or whether he merely mentions them as a well-known device for lessening sparking. Brushes of this type were tried at Messrs. Mather and Platt's, in 1883, to get over the sparking difficulties with the old Edison dynamos. The plan of inserting resistance in the connections from the armature to the commutator was tried, and afterwards laminated brushes, in some of which the copper was interleaved with a high resistance metal, such as German silver, while in others an insulating substance was used, such as mica. The Edison-Hopkinson non-sparking dynamo, however, rendered these devices unnecessary, and nothing more was done with them.

Claude W. Hill.

8, Guys Cliffe, Bradford,
July 5th, 1897.

[Mr. Mordey's paper was published in full.—Eds. Elec. Rev.]

MULTIPLE EXPANSION ENGINES AND THE COST ACCOUNT.

The tendency to over experiment in steam engineering is one that should be guarded against, especially by the younger engineers who are apt to pay more attention to the economies which ought to accrue by reason of a given system of procedure, than they do to the little practical losses which, in the aggregate, prevent the attainment of the hoped for economical results. Expansive working of steam is one of the fetishes now almost exploded, which at one time held the field. Americans, with their ingeniously contrived early trip gears, were blind followers of expansion far into those regions of the diagram that a more mature experience has shown to be unnecessary, in fact, undesirable. Prof. Thurston recognises this, and writes in the *American Electrician* to show how there may be too much expansion.

In the old days, as shown by Clark, Hirn and Isherwood, it was found that with pressures of 25 to 40 lbs. on the gauge, an expansion of 2·5 times was as much as could be wisely entertained. The reason, of course, lies in the internal wastes which come under the head of cylinder condensation. Then again, even the most economical engines were not found really the cheapest to use, especially where fuel was cheap, for their cost, when worked at the highest economical expansion, might easily outrun the little bit of fuel. When Hornblower failed to make much of a success of the compound engine, it was because he did not use steam of a sufficient pressure to warrant the two cylinders, and curiously enough, the late Daniel Adamson, to whom the world owes so much for his efforts to raise the tone of boiler making, made the same mistake when he put down the first quadruple expansion engine at Oldham, for he had only a boiler pressure of 100 lbs. When the compound engine was brought to success, it was found that in place of a terminal pressure of 15 lbs. for condensing simple engines, the expansion could be carried down to 10 lbs., and expansion ratios could be economically raised 50 or 100 per cent.

It began to be recognised that increased cost and complication could only be justified by high priced fuel, and the ability to use high pressure steam, and it was not until 1874 that the triple-expansion engine was introduced at sea, and maximum pressures of 75 and 100 lbs. gave way to pressures of 120 lbs. and higher, while to-day the ability to carry 200 lbs. is bringing forward the quadruple engine.

Dr. Thurston evidently believes in the heat trap theory, once so much sneered at as being the reason of economy in compound steam engines; and Dr. Thurston is right, for to this, and, perhaps, less internal differences of pressure, and so less internal leakages at pistons may be set down all economy.

With one, two, three, and four cylinders, the ratio of expansion may be 2½ to 3, 6·3 to 9, 16 to 27, and 40 to 81 respectively, for absolute pressures of 25 to 30 lbs., 60 to 100 lbs., 120 to 300 lbs., and 350 to 800 lbs.

Thus it would seem very doubtful if five-cylinder expansion is ever likely to be realised. When it is considered that the thermo-dynamic efficiency of an engine can only increase in the ratio of the log. of the pressure, and that even this slow rate is still further retarded by the extra thermo-dynamic wastes, it is easy to see that limits to progress must be placed far below the top limit. At most 50 per cent. economy would accrue to a pressure of 1,000 lbs. as against 100 lbs. Economy in multi-cylinder engines arises because the first hot steam goes into a very small cylinder, which has a small surface to act prejudicially on the steam. The initial condensation is therefore small, and the range of temperature is also moderate, and when the steam leaves the cylinder and goes forward to the next one, it carries no water with it, for this is re-evaporated, and so on from cylinder to cylinder the steam passes on, and the loss from internal condensation is roughly the inverse of the number of cylinders.

To select the really most economical steam plant is thus largely a question of equation between the fuel cost and the interest cost, and maintenance of more costly plant. At the same time we must remember that while we may add to the cost of engines, we can usually reduce the size of our boilers, and this counts for a good deal in a costly modern boiler. We need not follow Dr. Thurston into an examination of a series of curves which he suggests may be constructed from known results as a guide to the choice of the best steam plant. As he himself says, the best for any condition will be something less economical than the maximum. It is, he points out, fortunate, that where a high efficiency is sought, the range of expansion, as given above, may be most widely varied from the exact point of maximum economy in that class of engine that would necessarily be employed, and which can use steam over a wide range of expansion with small difference of efficiency. To this we would add that the lower ranges of expansion in the limits given are apt to prove the most economical both in fuel and in first cost of plant.

The corollary to the above would seem to be that with superheating the number of cylinders could be decreased, and the ratio of expansion in each cylinder increased. If such turned out to be the case, there would be a saving of cost in the engine, that would go some distance in the provision of the superheating plant. There is as yet an absence of data to confirm this opinion. It is, however, clear that some of the hindrance to progress in steam engineering has been caused by want of appreciation of the effect of cylinder wall action and steam pressures. It was the latter which stopped both Hornblower and Adamson in their well intentioned experiments.

THE DANGERS OF ELECTRICAL GENERATING WORKS.

The Departmental Committee appointed by the Home Secretary to inquire into dangerous trades, have issued an interim report dealing with electrical generating works. The following are the recommendations of the Committee:—

For the purposes of these regulations a station where the direct current generated is at 700 volts or any higher number, or where the alternating current generated is at 350 volts, or any higher number, shall be considered a "high pressure station," and all metal conductors, whether they be on the dynamos, the switchboard, the mains, or any other part of the station carrying a current at a pressure equal to, or greater, than that above mentioned, shall be deemed to be at "high pressure."

The Committee recommend that the following regulations should be applied in all those cases mentioned in Paragraph 1, where electricity at high pressure is in use. It is not intended that they should be applied to low pressure systems:—

1. The frames and bed-plates of all generating machines shall be efficiently connected to earth.

2. The rails fencing dynamos, or other generating machines, shall be made of wood or other non-conducting material.

3. All terminals, collecting brushes, main connectors, parts of dynamos, motors, or other appliances, to which neither Regulation No. 6 nor No. 7 applies, shall be so placed, covered, or fenced with non-conducting materials, that no person can touch accidentally, either with his body, clothing, or any conducting tool, two parts differing from each other by an amount which constitutes a high pressure. This rule is to be read in connection with No. 4.

4. The floors of all places where it would be possible to make connection with metal at high pressure shall be covered with an insulating mat of suitable material and kept in a state of efficient insulation.

5. The material used for wiping or cleaning the commutator strips or collector rings of dynamos, motors, or rotary converters of any form shall be applied by means of an insulating handle.

6. In switchrooms and on the front of switchboards, the main switches, main fuses, main terminals, omnibus bars, and all other metallic parts shall be insulated or arranged in such manner as to render it impossible for any person by accident or inadvertence to touch them.

7. The backs of all switchboards shall be kept closed, except for the purpose of alterations or repairs. When such work has to be

carried on either at the back or at the front of switchboards, the following regulations shall apply:—

(*a*) No person except a skilled electrician, or a workman under his personal and immediate supervision, shall be employed when any part is at high pressure.

(*b*) No extensive or serious repairs shall be executed upon metal which is at high pressure.

(*c*) Where the alterations or repairs are not of an extensive or serious character all metallic parts at high pressure shall be covered with an insulating cap or protected by some form of insulating covering, only one part, or several at the same pressure, to be exposed at any one time.

8. All switchboards erected after the application of these rules shall have at the back a clear space of at least 4 feet. This space shall not be utilised as a store room or lumber room, or be obstructed in any manner.

9. Any person at work upon a cable or portion of the mains under high pressure shall wear India-rubber gloves on both hands.

10. All aërial high pressure conductors in factories or workshops shall either be insulated over their entire length, and supported at such frequent intervals that, in the event of breakage, they shall not come within reach at places where persons are liable to pass or to be employed, or shall be so placed and arranged as to comply with the requirements relating to such wires in streets enjoined by the Board of Trade.

11. The gloves shall be supplied by the occupier, and it shall be the duty of the manager to see that they are in a proper state of repair, and are worn by the workpeople.

12. No examinations, repairs, or alterations necessitating the handling of mains, wires, machines, or other apparatus, shall be carried on except in cases of urgent necessity while such parts are under high pressure, and all such work shall be done under the personal supervision of an electrical engineer, or competent manager or foreman.

13. Where operations are being conducted upon mains from which the current has been cut off, the switch shall be locked, and precautions taken that it shall not be unlocked except by the person in charge of the station, on his being satisfied that the danger is at an end.

14. Every vessel used for lubricating purposes shall be so constructed that it cannot act as a conductor between the hand and anything touched.

15. Metal transformer boxes shall be efficiently connected to earth, and so constructed that in the event of "running to frame," the earth connection will not be broken by the removal of the fuse box or any other part of the box.

16. Transformer cases, iron ladders, and all permanent metallic parts contained within the transformer chamber, and not forming part of the electric circuit, shall be metallically connected together.

17. All holes in transformer cases, through which high pressure conductors pass, shall be lined or bushed with suitable and effective non-conducting material.

18. All high pressure connections within a transformer chamber shall be so protected with insulating material that it shall be impossible to touch them.

19. Switches which can be conveniently operated from the outside for cutting off both the high and low pressure connections of the transformers shall be fitted in all transformer chambers erected after the application of these Rules, and in all existing chambers, unless it is proved to the satisfaction of Her Majesty's Chief Inspector of Factories that such an arrangement would be attended by special difficulty.

20. Each post or support where series arc lighting is employed shall be provided with means for completely disconnecting the arc lamps from the mains, without disturbing the action of the other lamps.

21. All persons engaged in electrical works shall be made fully aware of the dangerous parts of the machinery, cables, and their connections, and shall be practically instructed in methods of artificial respiration—that known as Sylvester's is both simple and efficacious. Rules for artificial respiration, and for the restoration of persons apparently killed or injured, shall at all times be kept affixed in the station. All persons engaged in the works shall thoroughly understand these rules and be capable of putting them into practice. In the event of a person being rendered unconscious by an electric shock, artificial respiration shall, on the careful removal of the body from its electrical contact, be at once resorted to, and a qualified medical man immediately summoned.

22. All accidents occurring in generating stations or transformer chambers shall be notified according to the provisions of Section 18 of the Factory and Workshop Act, 1895.

The Committee feel that any set of special rules framed for the safety of the workpeople in this industry, must imperfectly realise their object if a specially qualified person be not retained to advise the Secretary of State or Her Majesty's Chief Inspector of Factories on matters requiring technical knowledge of electricity.

The suggestions for dealing with electric shock, which have been distributed gratis by the publishers of the Electrical Review, are given as an Appendix to the report.

STREET RAILWAY CONVENTIONS.

The next meeting of the American Street Railway Association is to be held at Niagara Falls, from October 19th to 22nd. It seems to be the fashion this year for American electrical societies to hold their festivities at Niagara. Papers will be read on the following and probably other subjects:—"Municipal Ownership of Street Railways;" "Modern Electric Railways: their Construction, Operation, and Disadvantages;" "Application of Electricity to Railroads now Operated by Steam Power;" "The Best Method of Settling Damage Cases, and the Prevention of Accidents by the Use of Fenders and Otherwise;" "Producer Gas for Use in Street Railway Power Houses and Gas Engines;" "Storage Batteries for Street Railways;" "Discipline of Employés;" "Long Distance Transmission and the Use of Multi-phase Current for Ordinary Street Railways."

Next year the tenth annual meeting of the International Tramway Association will be held in Geneva. The *Street Railway Journal* states that this association includes representatives of tramway companies of all European countries outside of Great Britain and Ireland. An idea of the vast field to be covered in the discussions may be gained from the following list of subjects:—

I.—*A.* What in your opinion are the most desirable dimensions to be adopted for the body and platforms of tramway cars. Do you think it desirable to increase the size of either the body or the platforms for different classes of service? Give your reasons in your reply.

B. What type of car do you recommend for electric traction: 1. For cars operating with overhead wire, or underground conduit? 2. For lines operated by accumulators?

N.B.—The first portion of this question has already been made the subject of a number of communications in reply to a question raised in 1896, but as yet has not been treated in a separate report. At the general meeting in Stockholm, it was decided to take up this subject at the next meeting.

II. *A.* What are the advantages, and what the disadvantages of employing single and double truck cars in operating lines with local traffic?

B. Is it possible by any arrangement to successfully reduce the dead weight of the car, while increasing its capacity?

C. Have you employed cars with radial axles, and if so, what have been the results secured?

D. Give a description and furnish plans of any system which you employ.

III. What brakes do you recommend for the following systems of operation:

First. For horse traction?

Second. For electric traction: (*a*) When single motor cars are used? (*b*) When trail cars are used?

Third. For traction by steam, compressed air, gas motors, &c.?

For mechanical traction kindly indicate if you prefer the use of a single or several brakes.

IV. From the standpoint of best service, what is the most desirable form of boiler and engine to instal in a power station?

V. What is the best method of bonding the rails:

A. For rails buried in the soil?

B. For rails placed on the surface of the ground?

VI. What type of track switches do you employ? Kindly furnish detailed plans. How are your switches operated? What are the advantages from the standpoint of installation? Do you consider it desirable to use switches with two movable points or with one movable point? Which of the two types do you recommend?

VII. What progress has been made concerning traction by accumulators:

A. From the standpoint of construction, of capacity, and of reducing the weight of the accumulators?

B. From the standpoint of durability and cost of maintenance?

C. From the standpoint of their economical and practical application to tramway traction?

VIII. What are the advantages and disadvantages actually met in practice with the different systems of electric traction?

IX. Have you anything interesting to communicate on the application of mechanical motors to tramway traction?

LEGAL.

Hewitt *v.* The British Insulated Wire Company.

This case came before Vice-Chancellor Hall, at St. George's Hall, Liverpool, on 5th inst. Mr. T. R. Hughes appeared on behalf of Mr. Hewitt, the holder of certain founders' shares, to support an application to restrain the defendants, the British Insulated Wire Company, Limited, of Prescot, and the liquidators thereof, from carrying into effect a scheme of reconstruction. Mr. Laurence, Q.C., appeared for the company.

Mr. Hughes stated that the British Insulated Wire Company was formed in 1890, and had since carried on business very successfully. They had now gone into liquidation with a view to reconstruction. His client was the holder of founders' shares in the original company, and of founders' shares only. There were also preference and ordinary shares. The scheme of reconstruction provided that each founders' share of £5 in the old company should rank for £50 nominal value ordinary shares in the new company. His client's case was that that was a very unjust scheme against the founders' shares, and did not represent anything like the founders' interest in the undertaking. He proceeded to state the facts, and to read from the correspondence which had taken place, from which it appeared that up to 1896 the founders' shares had not received any interest, but the accounts of 1896 showed that they were entitled to something like £100 per cent. It also appeared that the ordinary shareholders, the preference shareholders, and the holders of founders' shares, with the exception of the plaintiff—they being holders also of preference or ordinary shares—had agreed to the scheme of reconstruction, which was to increase the working capital.

After considerable discussion, Mr. Hughes said that the company had met his client very fairly in this matter. They had arranged

terms. "My client withdraws his claim to set aside the sale; the Registrar is to inquire what number of ordinary shares in the new company Mr. Hewitt would be entitled to in the event of the sale being carried through, and the proceeds are to be distributed in accordance with the rights of the members before alteration. The defendants undertake that they will retain a sufficient number of shares —an agreed number—to meet any claim of Mr. Hewitt ascertained in that way: and we have arranged as regards costs."

Mr. Laurence; That will put an end to this action, except as to this inquiry; and the new company will now proceed to allotment, and the reconstruction scheme will be carried through.

His Honour concurred.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week Ending July 6th, 1896.	£	s.
Amsterdam	130	0
Auckland	50	0
Barcelona. Teleg. cable	33	0
Bilbao	20	0
Bombay	283	0
Boston	61	0
Boulogne	41	0
Boca. Teleg. mat. ...	241	0
Bremen	39	0
Brussels	972	0
Buenos Ayres	500	0
Cape Town	87	0
,, Teleg. mat.	9,482	0
Calcutta	50	0
Colombo	26	0
Copenhagen. Teleg. mat.	24	0
Durban	24	0
East London	2,142	0
Flushing	71	0
Gibraltar. Teleg. mat.	49	0
Gothenburg. Teleg. mat.	851	0
Hong Kong. Telephone	19	0
King George's Sound ...	38	0
Launceston	649	0
Melbourne	152	0
,, Teleg. mat.	568	0
New York	41	0
Ostend	52	0
Passages	1,775	0
Pysanoko. Teleg mat.	800	0
Penang	280	0
Port Elizabeth	144	0
Rotterdam	421	0
St. John's, N.B. ...	15	0
Santander	6	0
Singapore	49	0
,, Teleg. mat.	365	0
Suakim. Teleg. mat. ...	14	0
Sydney	922	0
Tientsin	48	0
Wellington	99	0
Yokohama	152	0
Total	£21,785	0

Week Ending July 6th, 1897.	£	s.
Adelaide	109	0
Amsterdam	260	0
Antigua. Teleg. mat. ...	22	0
Antwerp	48	0
Barcelona	50	0
,, Teleg. mat.	85	0
Bombay	92	0
Brisbane. Telephone cable	1,808	0
Boulogne	18	0
Calcutta	627	0
Cape Town	188	0
Clinde. Teleg mat. ...	910	0
Colombo	74	0
Durban	223	0
East London	343	0
Flushing	30	0
Fremantle	67	0
Hamburg	10	0
Madeira	245	0
Madras	39	0
Malta	23	0
Melbourne	196	0
New York	60	0
Port Elizabeth	79	0
Rio Janeiro. Teleg. mat.	1,078	0
Rouen	100	0
St. Petersburg	12	0
Singapore	110	0
,, Teleg. mat.	50	0
Stockholm	500	0
,, Teleg. wire ...	20	0
Sydney	98	0
Teneriffe	10	0
Wellington	305	0
Yokohama	60	0
Total	£7,949	0

Foreign Goods Transhipped.

	£	s.
Brisbane	279	0
Rotterdam	31	0
Shanghai. Teleg. mat.	51	0
Total	£361	0

	£	s.
Launceston. Electric meters	400	0
Total	£400	0

A Novelty in Arc Lamp Business.—One of the neatest pocket catalogues we have seen lately is that just issued by Messrs. W. Lucy & Co., Limited, of Oxford, for which firm Mr. J. Hardie McLean, M.I.E.E. (until recently with the Oxford Electric Company), is acting as engineer. The catalogue deals specially with arc lamp-posts, but also contains some very useful rules, formulæ, &c., and is, in short, a combined catalogue and text and memoranda book, such as we believe electrical engineers will find useful. We believe Messrs. Lucy's special point is that they undertake to supply arc lamp-posts fitted with arc lamps of any make, also switches, cut-outs, and resistances complete, and undertake also to erect them, so that a municipal committee instead of going to half-a-dozen different manufacturers, can give out the whole of the work of supplying and fitting complete arc lamps and posts under one contract. This seems to us a good step, which, we believe, will be found to be successful. Experience has shown that great difficulty is found in fitting together by local labour the different apparatus supplied by separate makers. By Messrs Lucy's method when the posts arrive at their destination they are ready for erection and connecting to the service mains, properly protected connections being provided in the base of each lamp for this purpose. Messrs. Lucy manufacture and supply Mr. McLean's patent automatic devices, also arc lamp-posts designed to carry trolley wires for electric tramways.

Annual Outings.—The employés of the Incandescent Electric Lamp Company, Limited, held their annual excursion on Saturday last. About 150 employés, accompanied by the managing director and the staff, proceeded to Margate, and a most enjoyable day was spent. An excellent dinner and tea were provided at Lilley's Hotel.

We understand that about 600 of the employés of the Brush Electrical Engineering Company came to London last week from Loughborough for their annual trip.

The employés of Messrs. F. Ball & Co., electrical engineers, of Bristol, went for their annual trip on Saturday last to Bedminster. Dinner at the Portcullis Hotel was followed by various sports.

Amalgamation.—Arrangements for the amalgamation of the firm of Lund Bros. & Co. with that of Messrs. Ashwell and Nesbit, heating, ventilating and hydraulic engineers, of London and Leicester, have now been completed. This amalgamation will take effect as from January 1st, 1897, and the head office will be 12, Great James Street, Bedford Row, W.C. Mr. Richard Lund will continue to personally superintend the electrical department of the amalgamated business. All communications should be addressed to 12, Great James Street, Bedford Row, W.C.

Alternating Motors.—The Davies Motor Company, Limited, inform us that, having acquired the business and works of Messrs. Nalder Bros. & Co., 16, Red Lion Street, Clerkenwell, they are now manufacturing alternate motors under the Langdon-Davies patents, and are prepared to take orders for motors up to 10 H.P. They are prepared to show machines running to intending purchasers by appointment. The testing instrument business of Messrs. Nalder Bros. & Co. is still continued at the same address and under the same management.

Arc Lighting.—Messrs. Crompton & Co. send us a list of their specialities in connection with alternating current arc lamps, compensating coils, and transformers. The compensating coil performs the treble function of regulating the length of the arc, acting as an automatic cut-out, and is a substitutional resistance to take the place of the lamp when cut-out. We notice that the compensating coils get over a difficulty which may have been experienced by some of our readers through the carelessness of those who have to attend to arc lamps in shops by letting the carbons burn out. With the arrangement of compensating coil it is stated to be impossible for the shunt of the lamp to be burnt up, as there is no shunt to burn up; nor is it possible for any other damage to be done, as the compensating coil entirely takes the place of the lamp, and the only result of the burning out of the carbons is that the lamp goes out, without interfering with the other lamp or lamps in any way. The small arc lamp transformers are stated to be suitable for working a single lamp off the low tension mains. The transformer has only a single winding. The two ends of the winding are coupled across the mains at 100 or 110 volts, or even at 200 or 220 volts. Two other terminals are provided at proper points midway between the two ends on this winding, and to these terminals the arc lamp is connected. The result is that the energy taken from the mains is approximately only that required to work the one lamp. This is important, as it is often found that a consumer requires only one lamp but feels himself forced to take two as the energy he consumes is no more than if he only has one. In some instances also one lamp only is fitted, the energy which might well drive another being absorbed in a resistance coil. The arrangement offered is not the same as an ordinary transformer to transform down from 100 volts to 33 or from 200 volts to 33, as Messrs. Crompton work with only one winding, and only, as it were, partly transform energy. A higher efficiency is therefore obtained.

Arc Lamps.—For some days a number of "Mensing" arc lamps for electric lighting will be on public view at the electrical engineer's office, Market Passage, Manchester. These lamps are being manufactured by Messrs. P. R. Jackson & Co., of Manchester, and are claimed to be the simplest and among the strongest lamps made. A local paper says: "With the alternating lamps for shop lighting at present in use in Southport, only two in series can be run off the low tension circuit, but the Mensing lamps can be run in a series of three. They are cheaper than the lamps at present available, and being much simpler in construction, will cost less in repairs. The current can be varied from 5 to 25 amperes with very little trouble, and though a lamp running at 5 amperes cannot, of course, give so much light as one running at 25, it runs with perfect smoothness, whether at one extreme or the other. Similarly, vibrations or shocks do not affect the steadiness of the light. Indeed, we saw the inventor do such things, striking the lamp with a mallet, for example, as would have completely thrown other lamps out of gear, though without having the slightest appreciable effect on his."

Catalogues.—Messrs. W. H. Willcox & Co., of Southwark, have issued what they term a pocket-size catalogue, the pages of which have been reduced from the large lists, while several additional novelties lately brought out have also been included. Lubricators, oils, belting, hose, pumps, steam fittings, and a great variety of engineers' tools, machinery, and sundries, are described and priced in the 190 pages.

Messrs. Thomas Parker, Limited, of Wolverhampton, have issued a second edition of their pocket list dated June, 1897. The list is very nicely got up, and contains some good process blocks showing their continuous current dynamos and motors, also direct coupled plant. A copy of general specification of standard pattern dynamos and motors, also a good deal of tabulated information are included in this little 50 page book.

Correction.—The Edison Company desire to call attention to an omission in their advertisement on page xiii. The addresses should be Ponder's End, Middlesex, and Broadheath, Manchester.

Coventry.—The Consolidated Telephone Construction and Manufacturing Company have completed the first instalment of the electric light at the principal club in this city, and further extensions are to be made.

Creditors' Meeting.—The liquidator (Mr. A. J. Channon) announces that a meeting of the creditors of the Indestructible Ignition Tube Syndicate, Limited, in liquidation, will be held at Winchester House (Room 21), Old Broad Street, London, E.C., on Thursday, July 15th inst., at 3 o'clock p.m.

Steele & Johnson's Earthing Device.—We illustrate below this earthing device, which is made by Messrs. Veritys, Limited. The object of such devices is to ensure safety where installations are connected to a high tension system through transformers. However careful the construction of a transformer, there is always more or less fear of the insulation between the coils breaking down, in which event the primary current may pass into the low tension or house

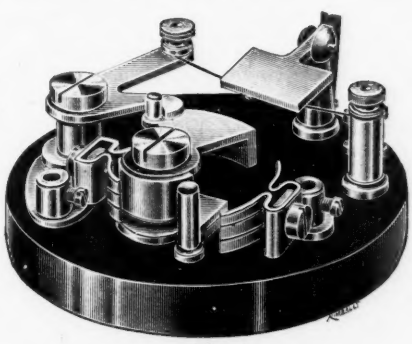


Fig. 1.

wires. An automatic safeguard for this is the earthing device, as in the event of such a leakage the low tension system is connected to earth, blowing the primary fuses, and preventing further danger. Fig. 1 shows Steele & Johnson's patent earthing device without cover. Points claimed in its favour are accuracy and certainty of action, independence of adjustment, and facility of inspection and resetting

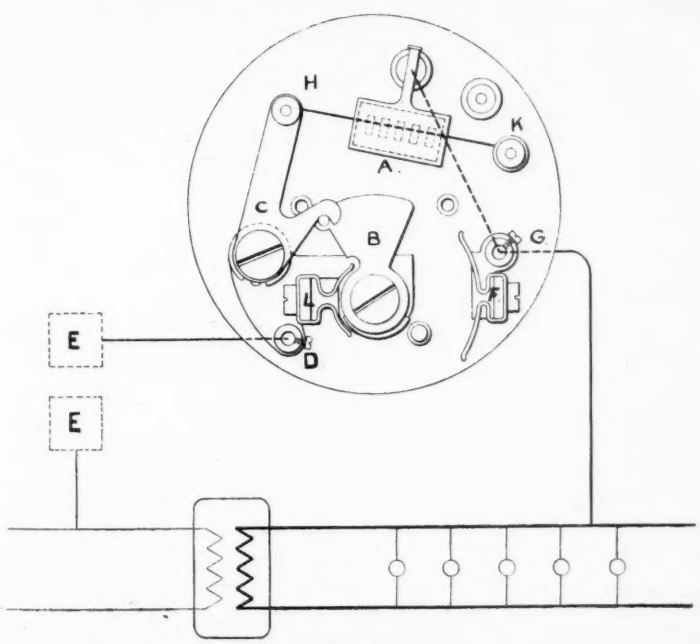


Fig. 2.

after action. In this device, the connection of the secondary main to earth is not of a permanent nature, but comes into operation only in the case of a leakage in the transformer. The old plan of permanently connecting one of the low tension mains to earth laid a greater strain on the insulation of the other conductors. This device in no way depends on static electricity for its action, as the acting forces are very small and the working parts necessarily delicate. It consists of an arrangement by which a pre-arranged sparking distance separates two metallic conductors, one of these being a short length of fusible wire stretched between two upright pillars and in connection with one pole of the low tension system, while the other is a metallic plate connected to earth. A perforated sheet of mica, of pre-adjusted thickness, separates the metal plate from the stretched wire. In the event of the high tension current leaking into the secondary or low tension system, a spark will pass from the fuse wire through the perforated mica to the metal plate, and so to earth. The fuse wire is by this means instantly severed, and a spring contact switch, formerly retained in an "off" position by the stretched wire, puts the secondary main to earth. The thickness of the mica is adjusted to form a sparking distance for a potential difference of usually 400 volts. The exact sparking distance is capable of easy adjustment. Slips of mica of the correct thickness can be kept in the instrument ready for immediate use, and inserted without fear of error. Fig. 2 is a diagram of connections. B is the contact maker of a switch, and is capable of making connection between the contact pieces, L and F. B is held in an "off" position against the force of a spring by the movable arm, C. The latter is provided with a hook which engages with a pin on the contact maker. A fine wire is stretched from a terminal on the pillar, K, to a terminal, H, on the arm, C. When it is desired to set the instrument for action, B is hooked in the "off" position as described by means of the hook on C, and the latter is secured by fixing the fine wire tightly between H and K. A is a hinged metal flap, to the underside of which a strip of perforated mica is secured by suitable clips, and by means of a spring this flap is capable of being tightly pressed against the wire stretched between H and K. The block terminal, G, in connection with the contact. F, is connected to one pole of the secondary or lamp wires. The flap, A, is already in metallic connection with the terminal, G. The terminal, D, is connected to earth. Each of these connections should be made with a wire the size of which is not less than the equivalent of No. 14 S.W.G. In the event of a leak between the high tension system and the low tension system, the increased E.M.F. will cause a spark between the plate, A, and the stretched wire, through the perforation of the mica. The thin wire being by this means instantly severed, B is no longer held in position by the movable arm, C, and at once makes contact between L and F, putting the secondary mains to earth.

Fires.—Messrs. J. F. & G. Harris, moulding manufacturers, &c., of 58, Wilson Street, Finsbury, E.C., inform us that the fire which occurred at their mills last Friday morning, July 2nd, has destroyed a portion only of the machinery and buildings, and has in no way interfered with the stock. Business is being carried on as usual.

There was a slight fire on the morning of the 1st inst. at the Brush Electrical Engineering Company's Falcon Works. It appears that the woodwork at the back of the foundry had caught fire. The damage done is very slight.

On Wednesday, last week, some extensive electrical works at Hamburg caught fire. It is stated that the valuable electrical machinery was completely destroyed by fire and sulphuric acid. The working of the electric trams in the city has been in some degree affected by the destruction of the works, though only to a limited extent, since the current which supplies the motor power is principally derived from other centres.

Liquidation Notices.—At a meeting of the Electrical Installation Company, Limited, held at 135, Victoria Street, S.W., on June 11th, a resolution was passed winding up voluntarily, as the company cannot, by reason of its liabilities, continue business. Mr. J. G. O'Brien, of the above address, was appointed liquidator.

At meetings of the Leeds and London Electrical Engineering Company, Limited, held at 15, St. Helen's Place, E.C., on June 1st and 17th, a resolution was passed winding up voluntarily, and appointing Mr. Walter Colls liquidator.

Notice to Creditors.—Mr. Arthur Goddard, liquidator of the British Electrical Manufacturing and Engineering Company notifies in the *London Gazette* that creditors are to send their names and addresses, and particulars of their debts or claims, to him at St. George's House, Eastcheap, E.C., on or before August 18th.

Partnership Notice.—Messrs. S. G. Trehearne & Son, of 155, Fenchurch Street, inform us that owing to increased business they have taken into partnership Mr. Arthur T. Crump, gas, water, and electrical engineer. Mr. Crump was for many years with A. S. Haslam, Union Foundry, Derby, lighting engineer to the Lancashire and Yorkshire Railway Company, and ventilating engineer to James Stott & Co., 174, Fleet Street, E.C. The firm will trade under the name of Trehearne, Son and Crump, at the old address.

Reduction of Capital.—Notice is given in the *London Gazette* that the petition for the reduction of the capital of the National Electric Supply Company from £54,750 to £39,693 15s. will be heard before the Vice-Chancellor of the Duchy and County Palatine of Lancaster on Monday, August 9th, at 10.30 o'clock at the Assize Courts, Manchester.

Stewart Electrical Syndicate, Limited.—We are informed that Mr. Stewart has withdrawn from the Stewart Electrical Syndicate, Limited, and Mr. Douglas C. Bate, Assoc.M.I.C.E., has been appointed as electrical and general manager. Mr. Bate is stated to have been largely responsible for recent improvements in the Stewart arc lamp. The syndicate is introducing new patterns and modifications of its ironclad resistances.

ELECTRIC LIGHTING NOTES.

Aston.—The Highways and Buildings Committee have received a notice from Messrs. Smith, Pinsent & Co., acting on behalf of the South Staffordshire Blast-furnace Power Syndicate, of the intention of that syndicate to apply to the Board of Trade for a provisional order.

Barton.—The Imperial Electric Light and Power Company, of Norfolk Street, Strand, W.C., have given notice of their intention to apply for a provisional order.

Belfast.—A Local Government Board inquiry will be held on July 15th into the Corporation's application for a loan for the erection of the new electric lighting station, &c. The question of refuse destruction was brought forward by Councillor Barklie at the last Corporation meeting.

Blackburn.—The Council will borrow £14,000 at 2½ or 3 per cent. per annum for electric lighting purposes.

Buxton.—Messrs. Farrer, Morgan & Co., solicitors, Manchester, notify the Council that they, acting on behalf of the Buxton District Light and Power Company, intend to apply to the Board of Trade for a provisional order. The Council will carefully discuss the matter.

Cardiff.—Messrs. Clay Bros. & Co. have been entrusted with the carrying out of the lighting of the Exhibition Building of this town for the Marquis of Bute. The installation will consist of 1,050 incandescent lamps of 32 C.P., and 10 arc lamps. The same firm has also in hand the lighting of Messrs. David Rees & Co.'s new premises (The Hayes Market), 250 16-C.P. lamps and 16 10-ampere arc lamps with dynamo; Messrs. Morgan & Co.'s premises, The Hayes, 180 lamps of 16 C.P.; Methodist Free Church, 40 lamps of 32 C.P. and 30 16-C.P.

Darwen.—A Committee is visiting electricity works in Lancashire this week, for the purpose of obtaining information in view of the proposed establishment of electricity works at Darwen.

Durban, S.A.—A correspondent wrote on the 11th ult.:—"Electric light in the streets was switched on as a trial for the first time during last night and was highly satisfactory."

Dundee.—The Free St. Paul's Church is to be redecorated shortly, and an electric light installation will be put in by Messrs. James Maxwell & Son.

Eastbourne.—The Eastbourne Electric Light Company are to extend their mains down several thoroughfares. The Council's permission has been given.

Eccles.—The Council is to apply to the Local Government Board to sanction the borrowing of £1,565 12s. 6d. to defray the expenditure incurred by the late Local Board and the Council in the matter of the electric lighting of the borough. The expense was incurred in respect of the provisional orders, the advice received from consulting engineers, the chief rent upon the plots of land purchased, the information obtained by deputations of the Council from other places, and the information which has been supplied to the burgesses.

Edinburgh.—The Corporation has been inviting tenders for the purchase of the following electrical plant:—Two Robey locomotive boilers, 140 lbs. pressure; two engines, Robey's compound; two Thomson-Houston arc dynamos; two ditto incandescent; screw-cutting lathe. The reason for the disposal of the plant is stated to be that the Library is now lighted from the city mains instead of the private installation.

Electric Light for Quarry Work.—The Norton quarries of cement rock have recently been equipped with an installation for electric lighting. The electric plant consists, says the *Engineer*, of a 30-kilowatt alternating current incandescent dynamo, driven direct by a horizontal engine. There are now in service 103 incandescent lights for the kiln shed, mills, packing and shipping rooms, &c. The quarries are lighted by 40 incandescent lamps and 14 arc lamps. The current is used at a pressure of 300 volts, being reduced by transformers to the necessary voltage for arc and incandescent lamps. Each arc lamp is operated by its individual transformer. In addition, one or two incandescent lamps on flexible cords, protected by wire cages, are operated from the same transformer when required. Arc lamps are also connected by flexible cords to the transformers, which are placed back of the nearest pillar to the face of the gallery. The lamps are supported from the roof of the gallery by means of ropes and pulleys, and give a satisfactory general illumination for the whole work. A suspended light is used by the men handling the drills and shovelling the broken stone in the loaded cars. Incandescent lights fixed in position are placed at the main platforms and turntable, while lamps for the purpose of general illumination are also placed at moderate intervals along the galleries now being operated. When the blasts are fired the lamps are unhooked and taken back behind the pillars. The electric light installation has entirely done away with oil lamps, the use of which in many cases rendered work almost impossible, since it was necessary to place the drills at the very top of the gallery on a shelf sufficiently below the roof for the erection of the drill. In the days of oil lamps the room was so filled with smoke and fumes that the men could only work there for a short time. The circuits are carried into the quarries from the power-house, a distance of about 400 feet in one direction, and 1,500 feet in the other. They are carried along the galleries, being fastened to insulators fixed to plugs driven into holes in the roof of the worked-out galleries. From various points main loops are carried to the galleries where the work is going on.

Enfield.—The District Council has requested to be supplied with particulars of the Imperial Electric Light and Power Company's proposals before consenting to that company applying for a provisional order.

Garston.—Mr. F. H. Medhurst has been appointed to prepare plans and estimates of the proposed electric lighting works and refuse destructor for the District Council.

Glasgow.—The Corporation had a discussion last week on the subject of the electric lighting of St. Andrew's Hall. The Bazaar Committee recommended that the matter be delayed until October; but the voting showed that 29 were in favour of immediate action in the matter and 24 in favour of delay.

Hamilton.—The Imperial Electric Light Company has announced its intention to apply to the Board of Trade for a provisional order to light the town with electricity. The Gas Committee will take the necessary steps to preserve the rights of the Council in the burgh.

Ilford.—The Works Committee has adopted a most peculiar course, and has referred the question of the proposal to light the town by electricity back to the Council. A special meeting of the Council will be called to discuss the matter.

Larne.—Messrs. Warden Stevens, F. F. Bennett, and Fawcus & Clirehugh, have offered their services as consulting electric engineers to the Commissioners.

Lewes.—It is stated that official notice has been given to the Town Council of the intention of a private company to apply for statutory powers to supply electricity for lighting and motive power purposes in Lewes.

London.—The Kennington Road Baths, which are to be opened by H.R.H. the Prince of Wales to-day, are lighted by electricity. The supply is obtainable either from the generating plant, which is placed in the basement of the building, or so far as concerns the glow lamps, from the mains of the London Electric Supply Corporation. Steam for the engines will be taken from the boilers which are used for heating the baths, the pressure being 90 lbs., there being three Lancashire boilers at present installed. There are two sets of engines and dynamos, one being of a direct-coupled plant, consisting of a Peach engine and Parker dynamo, good for 300 amperes at 110 volts, the other a belt-driven plant, comprising a Marshall horizontal engine and Parker dynamo, good for 70 amperes at 110 volts; 63 cells of the Blot type serve to supply the day load; these are charged from either of the two dynamos. They are divided into sections of 20, and the switchboard is arranged so that any two sections may be charged at one time. In discharging, the three sections are in series. Thus the cells can be charged in parallel with the lamps without the use of the usual back E.M.F. cells or external resistance. The switchboard is provided with Weston ammeters and a Kelvin voltmeter, while, in addition to the usual switches, there is provided a main change-over switch for connecting to the street supply mains. The lighting is effected by two 5-ampere arc lamps of the enclosed type, placed outside of the building, whilst about 480 glow lamps, varying from 8 to 32 C.P., are used for the internal lighting. For ventilating there are to be used seven electrically-driven air propellers by Messrs. Matthews & Yates, each having its own separate circuit. The whole of the wiring is enclosed in iron pipes, which have been specially treated inside to protect the wires and to obviate the rusting to which the damp atmospere of baths renders ordinary pipes particularly liable. Special draw-in and joint boxes of cast-iron have been adopted throughout, so that any circuit may be withdrawn and replaced when so required; a special point having been made of keeping all joints at these boxes to facilitate inspection. The electrical part of the installation has been carried out by Messrs. Geipel & Lange, successors to Messrs. Paterson & Cooper, of 68, Victoria Street, Westminster, under the superintendence of Mr. A. Hessell Tiltman, F.R.I.B.A.

At Saturday's meeting of the Metropolitan Asylums Board, the North-Western Hospital Committee reported that to complete the lighting of the whole of that hospital, a further extension of the work was required. Prof. Ayrton had prepared the specification, and tenders could be at once invited, the estimated cost being £250. The question was referred to the Works Committee to be dealt with.

Ludlow.—Inquiries are to be made on behalf of the Town Council (at a cost of 10 guineas) as to the advisability, &c., of establishing an electric lighting installation in Ludlow.

Melton Mowbray.—The Melton Mowbray Electric Lighting Company and the Melton Gas Company have both asked the District Council to sanction their applications for provisional orders for electric lighting. The applications have been referred to committee.

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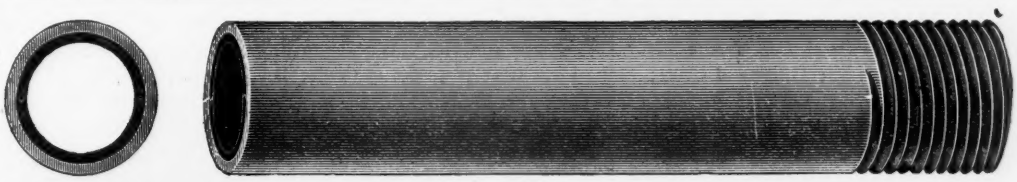

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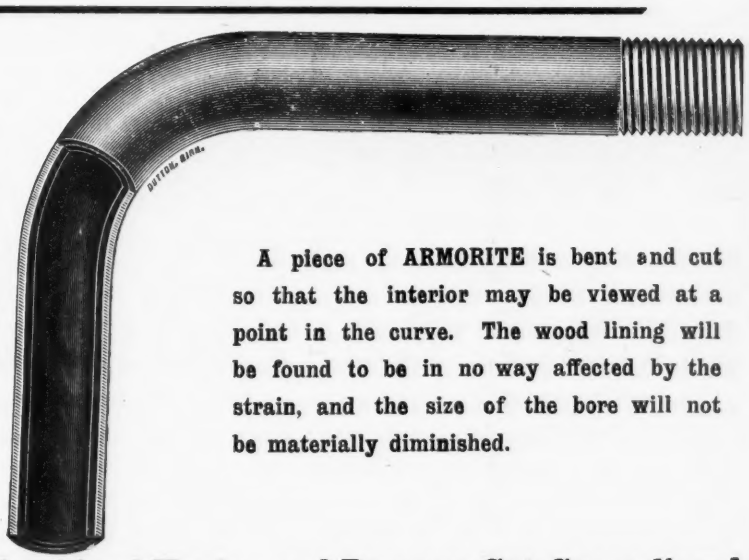

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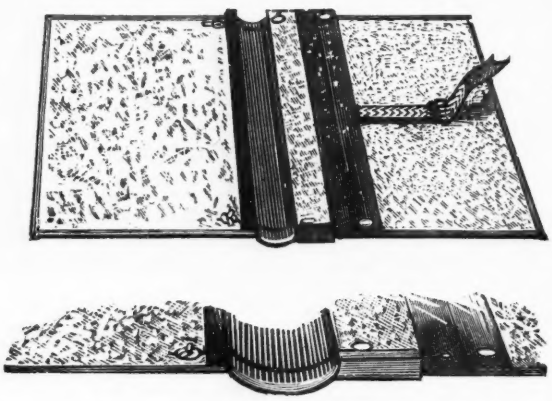

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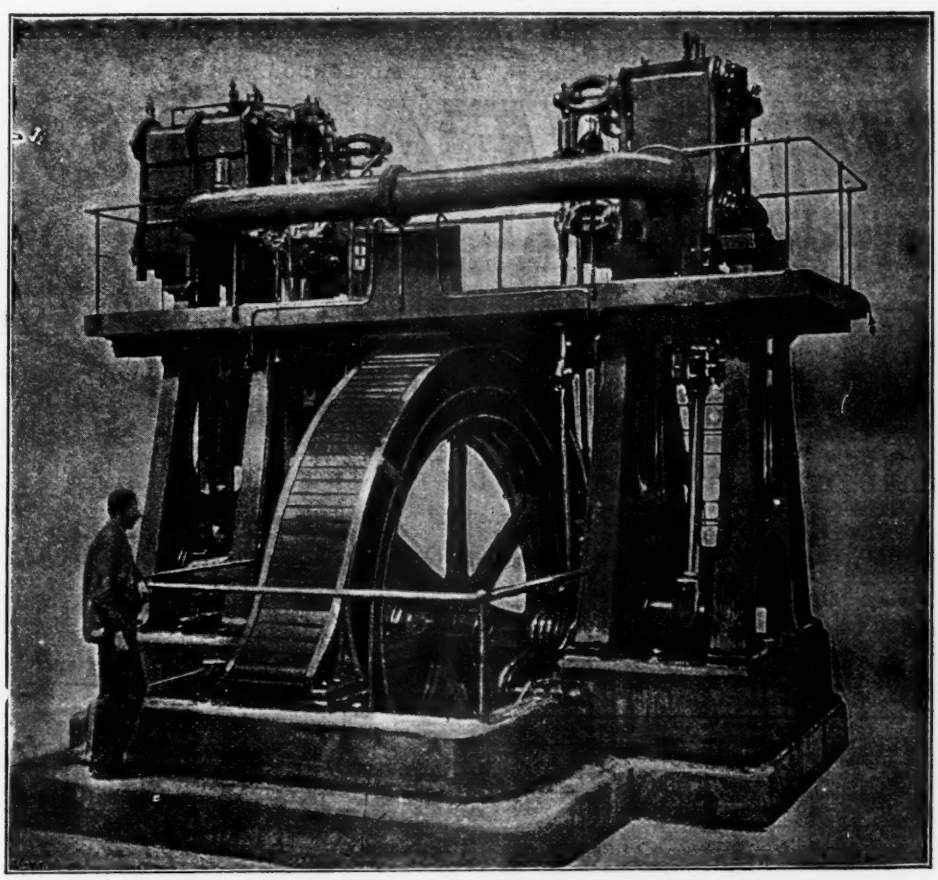

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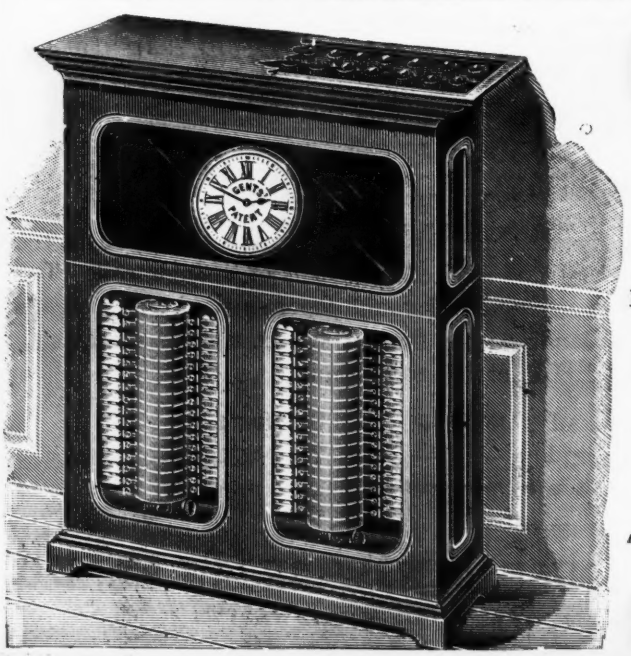

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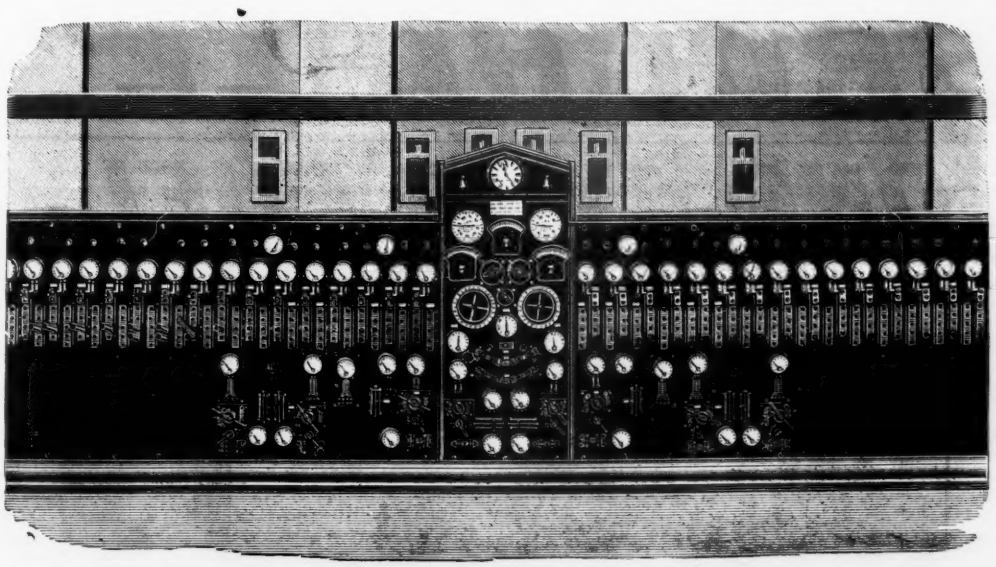

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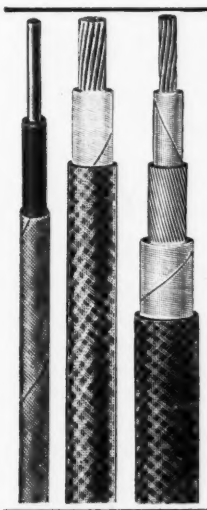

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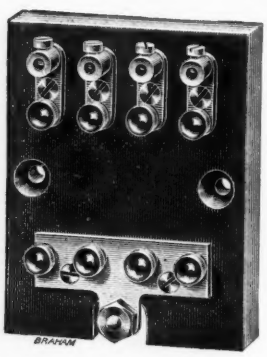

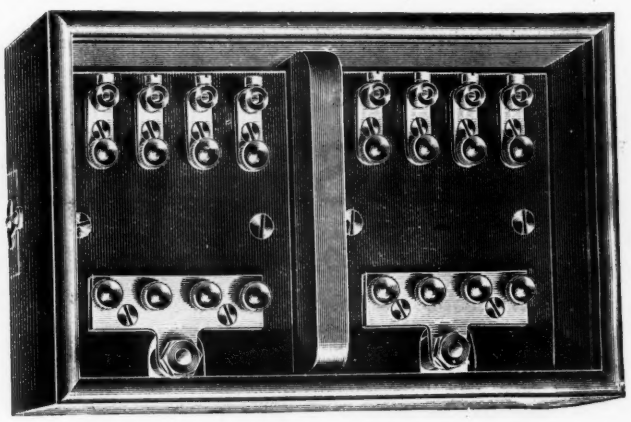

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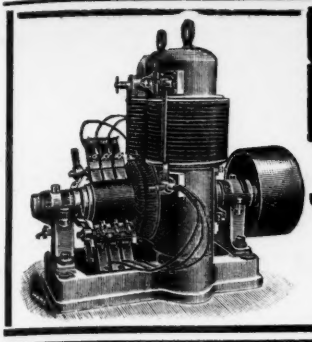

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DYNAMOS

2862

THE ELECTRICAL REVIEW.

PUBLISHED EVERY FRIDAY, PRICE 4d.
Office: 22, PATERNOSTER ROW LONDON.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY

NOTICE TO ADVERTISERS.

The following are the LATEST times up to which Advertisements can be received for publication in current week's issue:—
New Advertisements, or Alterations to existing ones, Wednesday 2 p.m.
Small Announcements for middle pages, Thursday 2 p.m.

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AND ARBITRATORS.

Average Annual Valuations exceed £1,500,000 Sterling.

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CHEAP PREPAID ADVERTISEMENTS,

Relating to *Situations Vacant, Situations Wanted, Businesses Wanted, Businesses for Sale, Patents for Sale, Specific Articles of any kind Wanted, or for Sale or Exchange, are inserted at the rate of* ONE PENNY *Per Word* (*minimum* 1s.).

Three consecutive Insertions for the Price for Two.

*** This Scale does not apply to Trade Advertisements, terms for which can be had on application.

SITUATIONS VACANT.

Where Advertisements are to be answered to a given number, letter, or *nom de plume* at the ELECTRICAL REVIEW Office, applications for names and addresses of the Advertisers will be entirely disregarded.

Original Testimonials should never be sent.

DRAUGHTSMAN, accustomed to designing dynamos, motors, and switchboards wanted.—1,263, ELECTRICAL REVIEW, 22, Paternoster Row, London. 1263

PREMIUM PUPILS.—Large electrical manufacturing works, near London, have several vacancies.—Address 1,278, ELECTRICAL REVIEW, 22, Paternoster Row, London. 1278

REQUIRED.—Young Electrician used to the charging of accumulators and able to instal and superintend installations of electric miner's lamps in collieries. — Apply, stating salary required, to "LAMP," care of Bates, Hendy & Co., 37, Walbrook, E.C. 1258

WANTED.—A smart Young Man with electrical knowledge and experience of costs, one who could be entrusted with catalogue work.—Apply, stating salary and experience, to 1,245, ELECTRICAL REVIEW, 22, Paternoster Row, London. 1245

WANTED at once for first-class electrical supply house, competent Salesman.—Apply, letters only, stating full particulars to "PERMANENCY," care of ELECTRICAL REVIEW, 22, Paternoster Row, London. 1262

WANTED, for electric cable factory, Engineer to take charge of testing of high (10,000 volts) and low tension cables, and carry out experiments generally. None but first-class men with good experience need apply.—State age, experience, salary required, and when disengaged, to 1,260, ELECTRICAL REVIEW, 22, Paternoster Row, London. 1260

WANTED, by a firm of electrical engineers and contractors, a thoroughly competent Engineer, capable of taking charge of, and carrying out power and light installations. Must be proficient in estimating and of good address.—Apply by letter only, enclosing references and salary required, to BERGTHEIL & YOUNG, 12, Camomile Street, London, E.C. 1253

WORKING FOREMAN Wanted for small works, experienced in electrical switchboard work, estimating costs, &c.—State wages and experience, 1,265, ELECTRICAL REVIEW, 22, Paternoster Row, London. 1265

VULCANITE.

HARBURG INDIA-RUBBER C. COMPANY.
London Warehouse: F. WINTER, 138, London Wall, Wood St., E.C.

EBONITE. 1710

WORKS MANAGER Wanted, experienced in dynamo construction, with thorough practical knowledge, energetic, and capable of turning work out quickly and cheaply; must be 6 o'clock man, and accustomed to charge of men, will not be required to undertake scientific work. State age, references, and salary required.—Apply by letter only, to Mr. CLAUDE W. HILL, Phœnix Dynamo Co., Hubert Street, Leeds Road, Bradford. 1248

WORKING FOREMAN Wanted, to take charge of fitters, turners, and machine men on dynamos and small engines, Yorkshire.—State experience, age, references, and wages required, 1,269, ELECTRICAL REVIEW, 22, Paternoster Row, London. 1269

WANTED Immediately, good Armature Winder. — Send references, age, &c., to 1,274, ELECTRICAL REVIEW, 22, Paternoster Row, London. 1274

WANTED.—A good working Foreman to take charge of a well-appointed electrical fitting factory in London.—Apply in confidence, by letter, stating experience and wages required, to 1,275, ELECTRICAL REVIEW, 22, Paternoster Row, London. 1275

WANTED Immediately, Traveller for installation work, must be energetic and have a good connection. Liberal terms. —Write, giving full particulars, and probable turnover, ALLAM AND CO., 14, Hatton Garden, E.C. 1283

WIREMAN and Carpenter (light), call at once.—WARD BROS., 13, Beer Lane, E.C. 1283

YOUNG MAN Wanted by Manufacturing Electrician as Traveller and Confidential Assistant. Preference to one able to invest small capital with view to ultimate partnership.—Address, 1,235, ELECTRICAL REVIEW, 22, Paternoster Row, London. 1235

SITUATIONS WANTED.

Where Advertisements are to be answered to a given number, letter, or *nom de plume* at the ELECTRICAL REVIEW Office, applications for names and addresses of the Advertisers will be entirely disregarded.

CHARGE HAND, with 11 years' experience in installation and general electrical work, seeks permanent situation. Good references.—1,277, ELECTRICAL REVIEW, 22, Paternoster Row, London. 1277

ELECTRICAL ENGINEER (24) desires re-engagement as Assistant in central station (low tension) or as Assistant Electrician. Highest testimonials.—1,226, ELECTRICAL REVIEW, 22, Paternoster Row, London. 1226

ELECTRICIAN desires charge of private installation, 9 years' experience.—Apply 1,264, ELECTRICAL REVIEW 22, Paternoster, Row, London. 1264

ELECTRICIAN (young) wants situation to take whole or part charge of electric light installation, or as an Assistant in central station, do own repairs, good armature winder.—"W. W.," 31, Ossington Street, Bayswater, W. 1269

ENGINEER requires situation at electric supply company, to take charge of engines, boilers, and their repairs, 9 years' experience with high-speed electric engines, good references.—"H. G. G.," 29, Victoria Road, Harborne, Birmingham. 1256

TRAVELLER, town preferred, disengaged, or position of trust —1,280, ELECTRICAL REVIEW, 22, Paternoster Row, London. 1280

WIREMAN, having had several years' experience in installation work, requires situation, would take charge of private plant —"G. C.," 170, Downham Road, Islington. 1273

[*Continued on next page.*]

ARTICLES FOR SALE AND WANTED, PARTNERSHIPS, &c.

Where Advertisements are to be answered to a given number, letter or nom de plume at the ELECTRICAL REVIEW Office, applications for names and addresses of the Advertisers will be entirely disregarded.

ACCUMULATOR RECHARGING.—Peto & Radford, Ltd., having increased their storage battery plant, are now prepared to make additional contracts for recharging accumulators of all sizes. Power available night and day. Telephone No. 6,994.—PETO & RADFORD, LTD., 57B, Hatton Garden, London, E.C. 9480

ACCUMULATOR Charging.—C. H. Cathcart & Co., having plant specially adapted for this purpose, charge cells of all sizes promptly, thoroughly, and cheaply. Terms on application. Accumulators on hire for temporary lighting, experimental uses, &c.—8, Dorset Buildings, Salisbury Square, Fleet Street, E.C. (Telephone No. 65,266). 7345

DYNAMO, &c., for Brussels Exhibition wanted on hire, three months, suitable for 160 16-C.P. lamps, with or without all fittings, also small dynamo and motor for elevator requiring 6 B.H.P. — Write STANSFIELD'S PATENT CO., 17, Rue Van Maerlant Brussels. A splendid advertisement. 1240

DYNAMO, shunt, 55 v., 35 amp., switchboard, arc light, and fittings of all kinds, vertical boiler, 5 H.P. donkey pump and injector. Offers wanted.—1,281, ELECTRICAL REVIEW, 22, Paternoster Row, London. 1281

FOR SALE.—One set of 55 E.P.S. cells, 7 K type, in glass boxes with trays, insulators, and all accessories, capacity 25 amperes at 100 volts for 3½ hours. Recently erected, equal to new. May be seen by appointment. — ELLIS & WARD, 115, Edmund Street, Birmingham. 1208

FOR SALE.—10 H.P. Robey fixed steam engine, No. 10,527, compound governor expansion with 12 H.P. Robey loco. type boiler, No. 10,528 (steel), insured 140 lbs. working pressure, both specially made for electric light; also Thomson-Houston series dynamo, 10 amps., with their patent regulator and controller; also 11 2,000-C.P. arc lamps, &c., &c.—Prices and full particulars on application to W. REYNOLDS, Coton, Cambs. 1238

FOR SALE.—27 complete vols. ELECTRICAL REVIEW, 1 to 27, six in publisher's cases, remainder half calf, first-class condition, also about two vols. unbound.—Offers to "TOMBSTONES," 34, Lilford Road, Camberwell. 1241

FOR SALE. — 25 "Jandus" continuous current arc lamps, 6 amperes, 120 volts. Lamps will be altered to 100 volts, if necessary, free of cost. Six "Jandus" continuous current arc lamps, 6 amperes, 230 volts. All complete with globes, quite new, never been unpacked.—For particulars, apply to D. SELBY BIGGE AND CO., Newcastle-on-Tyne. 1270

FOR SALE.—Well equipped electrical fittings manufactory, situate in London, in good working order, complete, with gas engine, lathes, polishing spindles, &c., and having a very first-class connection. — Apply 1,276, ELECTRICAL REVIEW, 22, Paternoster Row, London. 1276

MOTOR, direct, 50 volt, about ¾ H.P. wanted, E.C.C. preferred. —State price and particulars, 1,257, ELECTRICAL REVIEW, 22, Paternoster Row, London. 1257

NEWLY-BUILT Premises to Let in Bury Street, Fulham Road, Chelsea, very suitable as charging station for motor-car cells, or for small workshop. Electric supply laid on.—For further particulars, apply CHELSEA ELECTRICITY SUPPLY CO., 19, Cadogan Gardens, S.W. 1252

PARTNER Wanted, about £50, assist extending established London electric lighting connection. Good opening.—1,247, ELECTRICAL REVIEW, 22, Paternoster Row, London. 1247

PLATINUM in any form and quantity, purchased at highest prices by DERBY & Co., 44, Clerkenwell Road, London. 6522

SOUTH AFRICAN AGENCIES.—A well-established Johannesburg firm of mining engineers will consider offers of sole agencies for high-class electrical machinery and specialities.—1,246, ELECTRICAL REVIEW, 22, Paternoster Row, London. 1246

WANTED.—Two good secondhand shunt dynamos, 100 volts, 100 amps, speed 750 to 1,000—Apply READING INSTALLATION CO., The Arcade, Reading. 1254

WANTED.—Old scrap cable, wire, &c.; any quantity bought. —EDEY & Co, 29, Ludgate Hill. 1256

WANTED, Electric Lamp Tops and Scrap Platinum.—EDEY AND CO., 256, Ferndale Road, Brixton. a1006

Just Published. Crown 8vo, 4s. 6d. With Illustrations.

THE INDUCTION COIL IN PRACTICAL WORK:

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By LEWIS WRIGHT,

Author of "Light: A Course of Experimental Optics," &c.

MACMILLAN & CO., LIMITED, LONDON. 1092

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See Page Advertisement Third Friday of each month.

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Vide full advertisement in last issue, also next issue.

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Makers of all kinds of Electrical Plant, Hubert Street Works, Leeds Road, Bradford
See our Page Advertisement First Friday in each month.

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SMALL MODEL DYNAMOS,
10 volts, 6 amperes, 3,000 revolutions per minute, adjustable brush rocker, splendid finish, **Price, 30s. each.**

For Prices of all kinds of Electrical Accessories,
APPLY TO
S. HARRISON, Manufacturing Electrician,
Office—697, ORMSKIRK ROAD, PEMBERTON, WIGAN.
Works—ELLESMERE MILL, NEWTOWN, WIGAN.
Registered Telegraphic Address:—"HARRISON, PEMBERTON." 1107

MICA
For Dynamos, and all Electrical Purposes. Large stocks of all qualities on hand. Speciality, Mica for Commutators, cut to any shape, and of equal and uniform thickness.
SANDERS, WAKE & CO.,
Office—23 Great St. Helens, LONDON, E.C., Contractors to H.M. Government.
Telegrams—"Awake, London." Telephone—2,868, Avenue. a293

Cloth, Post Free, 2s. Illustrated with Working Drawings.
HOW TO BUILD A FIFTY-LIGHT DYNAMO
OR FOUR HORSE-POWER MOTOR.
By A. E. WATSON.
TO BE OBTAINED FROM
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22, Paternoster Row, London.

SIMPLE THINGS PRODUCE GREATEST RESULTS.
BAYLEY'S
COMMUDINE
Preserves insulation between Sections. Prevents copper dust adhering. Reduces Sparking, Brushes wearing, which means less copper dust, and so keeps Commutators in perfect condition, without the aid of oil or grease. This liquid is pronounced by the most eminent Electrical Engineers to be perfect, and the most useful yet known. Commutators thus treated will wear twice as long, and so save expense, besides trouble.
Used by Railways, leading Electric Lighting Companies, and largest Firms in the kingdom.
The proof of its utility is by testing a bottle, which can be had of any **Electrical General Dealing Firms,** *or of the Manufacturer,* **A. L. Bayley, Moor Green, Birmingham.**
2/- per bottle; post-free, 2/6

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ALL KINDS FOR ELECTRICAL WORK, and also for INDIA-RUBBER & GUTTA-PERCHA MANUFACTURERS,
Solid Sulphuric Acid and Bichromate Salt for Export.
G. BOOR & Co., 1 & 2, Artillery Lane, Bishopsgate, LONDON, E.C.
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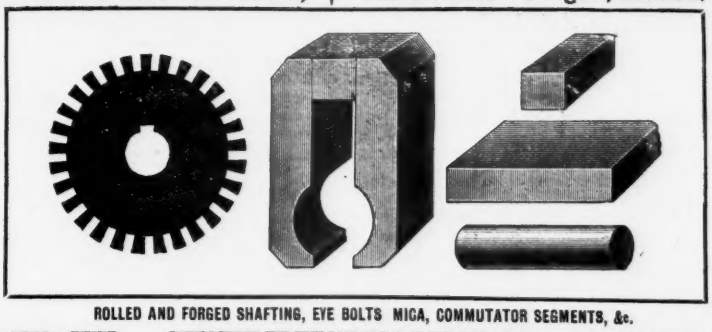

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Art Metal Workers.

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(IN FRENCH AND ENGLISH STYLES).
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Scale, approximately ⅓ full size.

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ELECTRICITY SUPPLY METERS,
PORTABLE TESTING SETS,
&c., &c., &c.

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JAMES WHITE,
18, CAMBRIDGE STREET,
GLASGOW. 3941

Official Notices.

1897, B. 063.

In the High Court of Justice, Chancery Division,
Mr. Justice Stirling.

In the Matter of the Companies Act, 1867,
and
In the Matter of the Companies Act, 1877,
and
In the Matter of the Brush Electrical Engineering Company, Limited and Reduced.

NOTICE IS HEREBY GIVEN that a petition, presented to the High Court of Justice, Chancery Division, on the 13th day of May, 1897, for confirming a special resolution, reducing the capital of the above-mentioned company, from £750,000 to £660,000, is directed to be heard before his Lordship on the 31st day of July, 1897. Any Creditor or Shareholder of the Company desiring to oppose the making of an order for the reduction of the capital of the said Company under the above Acts, should appear at the time of hearing by himself or his counsel for that purpose. And a copy of the petition will be furnished to any Creditor or Shareholder of the Company requiring the same by the undersigned on payment of the regulated charges for the same.

Dated this 1st day of July, 1897,

RENSHAW, KEKEWICH & SMITH,
Solicitors for the Company.

Witness, C. T. PRICE,
Solicitor and Clerk to
Renshaw, Kekewich and Smith,
2, Suffolk Lane, E.C. 1244

COUNTY BOROUGH OF BIRKENHEAD.

ELECTRIC LIGHTING OF WOODSIDE FERRY

TO ENGINEERS AND ELECTRICIANS.

THE CORPORATION OF BIRKENHEAD are prepared to receive Tenders for the Wiring and Lighting by Electricity, of the above.

Plans can be seen on and after JULY 5th, 1897, and a copy of the general conditions and specification, with form of tender, can be obtained after the same date on payment of the sum of One Guinea (to be returned on receipt by the Corporation of a *bona fide* tender), at the Town Clerk's Office, Town Hall, Birkenhead, or at the Office of Mr. JAMES N. SHOOLBRED, Mem.Inst.C.E., 47, Victoria Street, London, S.W.

The Corporation do not bind themselves to accept the lowest or any Tender.

Tenders, which must be on the prescribed form, sealed and endorsed "Tender for Electrical Wiring and Lighting of Woodside Ferry," must reach me not later than 12 o'clock noon on TUESDAY, JULY 20th, 1897.

By Order,
ALFRED GILL,
Town Clerk.

Town Hall, Birkenhead,
June 30th, 1897. 1238

THE DUNDEE GAS COMMISSIONERS.

TENDERS FOR COPPER STRIP.

THE DUNDEE GAS COMMISSIONERS are prepared to receive tenders for a supply of Copper Strip.

Specification and form of tender may be had on application to WALTER H. TITTENSOR, City Electrical Engineer, Dundee.

Tenders must be lodged with the undersigned (marked "Tenders for Copper Strip") on or before Tuesday, July 13th, 1897.

THOS. THORNTON,
Clerk of the Commissioners.

City Chambers, Dundee,
June 29th, 1897. 1225

HAMMERSMITH VESTRY.

TENDERS FOR ELECTRICAL STORES.

THE VESTRY OF HAMMERSMITH hereby give notice that they will be prepared at their next meeting, to be held at the Broadway Lecture Hall, on Wednesday, July 21st, 1897, at 6·30 o'clock in the evening, to receive tenders for Supply of Stores required for the Electricity Department for the period up to March 25th, 1898.

Forms of tender, and any other information may be obtained from Mr. G. GILBERT BELL, Engineer, on or after Monday, July 12th, 1897, between the hours of 9 and 5; Saturdays, 9 and 1.

The contractors are to attend personally, or be represented at the Vestry meeting, to deliver their own tenders, to wait until all tenders are opened, and to answer questions.

The Vestry does not pledge itself to accept the lowest or any tender.

By Order,
W. P. COCKBURN.
Vestry Clerk.

Temporary Offices,
57, Fulham Palace Road,
Hammersmith, W., *July 5th*, 1897. 1272

Official Notices.

GLASGOW CORPORATION TRAMWAYS.

ELECTRICAL ENGINEER Wanted, to act as Assistant to Tramways Engineer in equipping and working Springburn Route on the Overhead System. Salary £4 to £5 per week, according to experience. Only those having practical experience in traction need apply. Applications, with copies of testimonials to be sent on or before MONDAY, JULY 26th, to Mr. JOHN YOUNG, General Manager, 88, Renfield Street, Glasgow. 240

ROYAL TECHNICAL INSTITUTE, SALFORD.

Principal - W. WILSON, M.A.

APPLICATIONS are invited from duly qualified gentlemen for the post of Assistant Lecturer in Physics and Electrical Engineering. Salary £120 per annum.

Full particulars of duties and forms of application may be had, up to the 17th inst., from

RICHARD MARTIN,
Secretary.

July 5th, 1897. 1250

CORPORATION OF WORCESTER,

ELECTRICITY DEPARTMENT, GUILDHALL.

ENGINEER-IN-CHARGE.

THE ELECTRICITY COMMITTEE are prepared to receive applications for the post of "Engineer-in-Charge" at the Electricity Works. The duties consist of taking charge of the running plant during an 8 hours' shift each day, the superintendence of repairs to the plant, and such other work as the City Electrical Engineer may direct. Applicants must have received a mechanical training, and held a similar position in a high tension alternating current station. Salary £135 per annum.

Applications stating age, experience, and accompanied by copies of three recent testimonials, must be sent to me not later than JULY 17th, 1897, endorsed "Engineer-in-Charge."

E. T. RUTHVEN MURRAY,
City Electrical Engineer.

Guildhall, Worcester,
July 7th, 1897. 1271

PORTSMOUTH CORPORATION ELECTRICITY SUPPLY.

WANTED, a FOREMAN for work on street mains, preference will be given to a man having experience with transformers and arc lamps, wages 40s.

Applications by letter, stating age and experience, and enclosing copies of testimonials, should be received not later than JULY 17th. Address "APPLICATION,"

Electric Light Station,
Gunwharf Road,
Portsmouth. 1251

HULL CORPORATION ELECTRIC LIGHTING.

TEMPORARY PLANT.

THE ELECTRIC LIGHTING COMMITTEE of the Hull Town Council are prepared to receive Tenders for the supply, erection, and hiring of certain plant and machinery required in connection with the electric lighting installation during the winter of 1897-8.

Specifications for the above, with conditions of contract, and any further information, may be obtained at my office.

The Corporation do not bind themselves to accept the lowest or any tender.

Tenders, sealed and marked "Electric Lighting—Temporary Plant," are to be addressed to the Chairman of the Electric Lighting Committee, and to be delivered at the Town Clerk's Office, Town Hall, Hull, before noon on THURSDAY, JULY 29th, 1897

By Order,
A. S. BARNARD,
Borough Electrical Engineer.

Dagger Lane, Hull,
July 6th, 1897. 1

Sale by Tender.

COUNTY BOROUGH OF HUDDERSFIELD.

FOR SALE—50-UNIT GENERATING PLANT.

THE ELECTRIC LIGHTING COMMITTEE of the Huddersfield Corporation have for Disposal a 100 H.P. Compound Vertical Brush Engine, and a 50-unit Mordey Alternator (2,000 volts, 25 amperes).

Full particulars may be obtained upon application to Mr. A. B. MOUNTAIN, Borough Electrical Engineer, St. Andrew's Road, Huddersfield.

Sealed tenders, endorsed "Tender for Purchase of Plant," must be delivered, free of charge, addressed in the handwriting of the tenderer or his agent, to the Town Clerk, Town Hall, Huddersfield, not later than Wednesday, the 14th July, 1897.

The corporation do not bind themselves to accept the highest or any tender.

By order,
F. C. LLOYD,
Town Clerk.

Town Hall, Huddersfield,
June 23rd, 1897. 1102

Official Notices.

COUNTY BOROUGH OF NEWPORT.

EXTENSION OF ELECTRICITY WORKS.

THE ELECTRIC LIGHTING COMMITTEE of the County Borough of Newport (Mon.) are prepared to receive tenders for the supply and erection of the following plant for the extension of the Municipal Electricity Works (the whole bound up in one specification, price £2 2s., returnable on receipt of *bonâ fide* tender) :—

Section A.—
Boiler House Plant—Lancashire Boilers and Fittings, Mechanical Stokers, Feed Pumps, Economiser, Electric Motor, &c.

Section B.—
Steam and Exhaust Pipes, Valves, &c.

Section C.—
Engine House Plant—Steam Alternators and Exciters, Accumulators, Oil Filter and Tanks.

Section D.—
Switch Gear and Instruments.

Section E.—
Arc Lamps, Posts and Accessories.

Section F.—
Coal Elevator.

Section G.—
Allowance for Day-load Plant.

Tenderers are at liberty to tender for either Section, but not for part of a Section.

The ground plans of plant, and specification, with terms and conditions of tender and contract, may be obtained at the Offices of Mr. ROBERT HAMMOND, the Consulting Engineer to the Corporation, Ormond House, Great Trinity Lane, London, E.C., on and after Friday, July 9th, on payment of £2 2s for each copy, which sum will be refunded on the return of the specification filled up with a *bonâ fide* tender. Tenders (sealed and marked "Tender for Electric Lighting") must be addressed to me at the Town Hall, Newport (Mon), and be delivered on or before Friday, July 30th.

The Committee do not bind themselves to accept the lowest or any tender.

ALBERT A. NEWMAN,
Town Clerk.

Town Hall, Newport (Mon),
July 1st, 1897. 1267

Official Notices.

VESTRY OF ST. MARY, ISLINGTON.

ELECTRICITY SUPPLY.

WANTED, at once, a first-class Man to fill the temporary position of Canvasser. Only experienced men of good address need apply. Salary £3 per week and commission. Written application, with copies of not more than three recent testimonials, to be sent to the Electrical Engineer, 50, Eden Grove, Holloway, N., and to be received by him not later than noon on TUESDAY, JULY 13th, 1897. Personal canvassing will disqualify. Applications to be endorsed "Canvasser" on the outside.

WM. F. DEWEY,
Vestry Clerk.

Vestry Hall,
Upper Street, Islington, N.,
July 5th, 1897. 1266

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MANUFACTURERS OF
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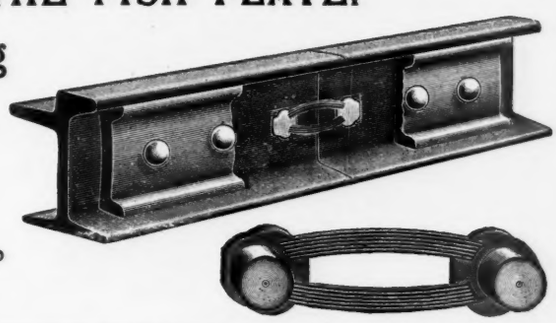

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AT

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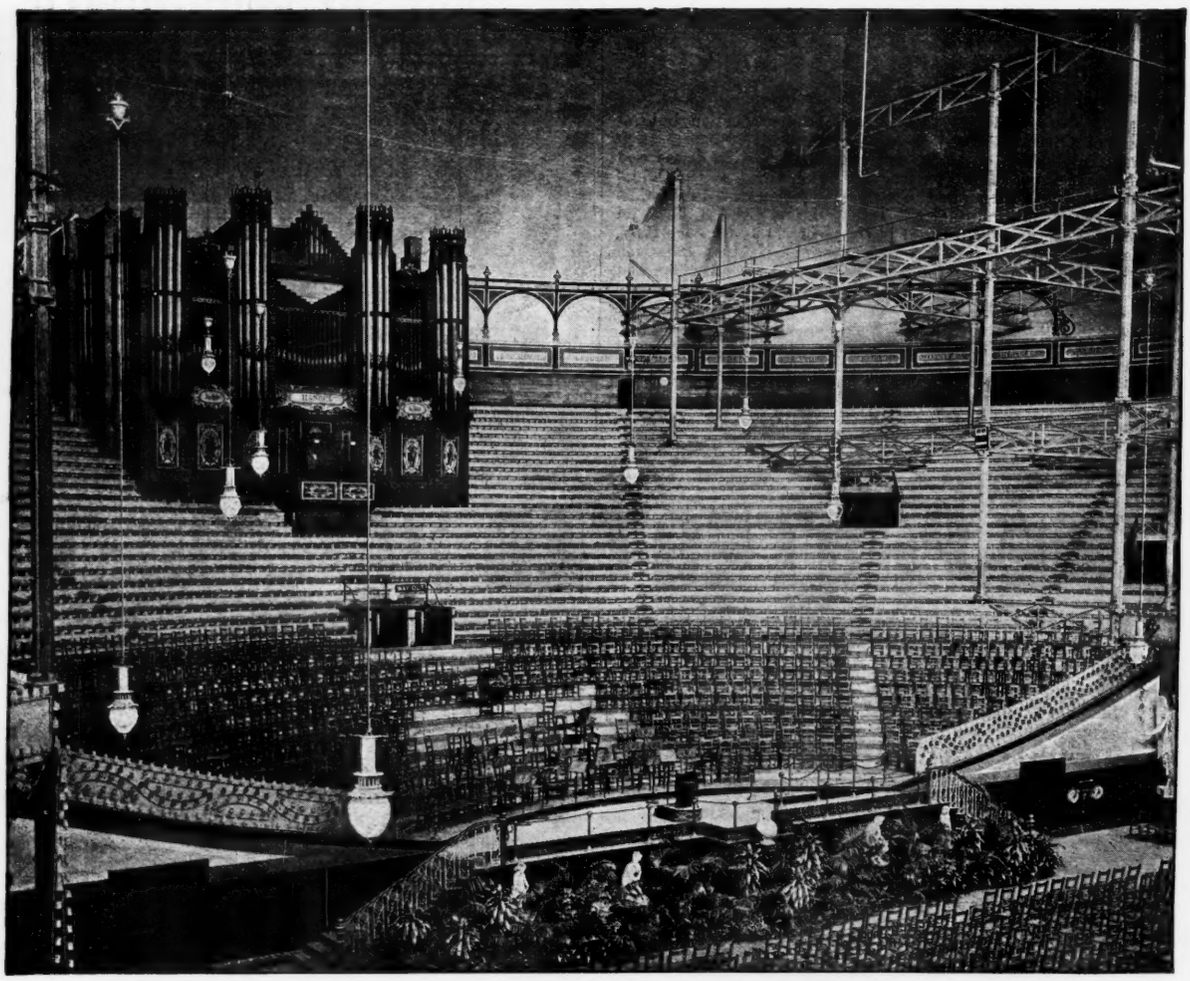

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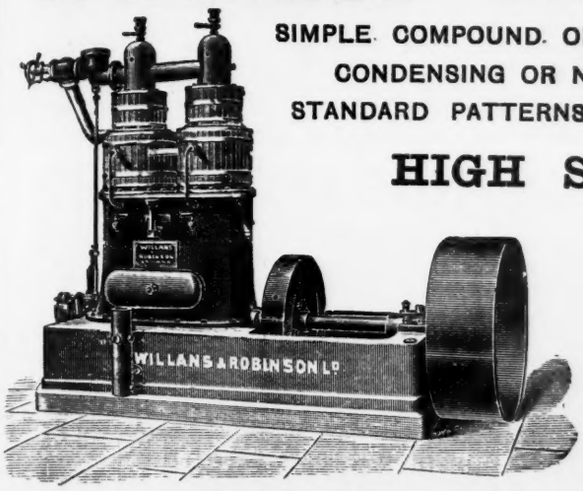

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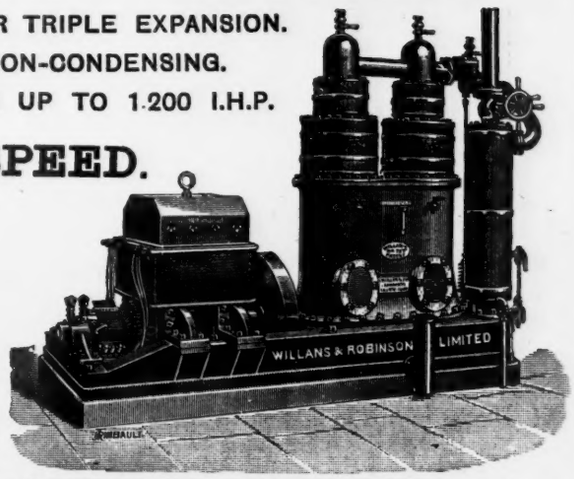

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SMALL SPACE OCCUPIED and corresponding reduction in first cost of buildings.

SILENCE AND DURABILITY, OWING TO ALL BRASSES BEING IN CONSTANT THRUST.

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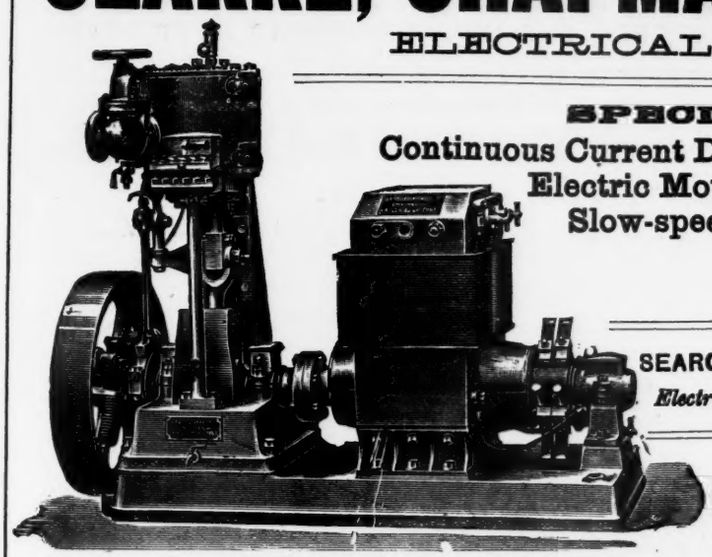

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Continuous Current Dynamos, Alternators,
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Slow-speed Direct-coupled
Engines and Dynamos
For Ship Lighting, &c.

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THE "ROYAL" INCANDESCENT LAMPS.

APPLY TO—

A. & W. HOPKINS,

30 Parliament Street,

LONDON, S.W.

10462

Manchester.—The Corporation Electricity Committee have submitted to the City Council the abstract of the accounts for the year ended March 31st. The particulars of the year's working and extensions show that progress continues and prosperity has been fully maintained. The number of consumers at the close of the year was 1,581, being an increase of 433 as compared with the previous year. The total quantity of current measured and accounted for was 2,775,107 units, or 91·64 per cent. of the quantity generated. The financial results of the year have been very satisfactory, and amount to £16,812 8s. 1d. This surplus, together with the balance of £1,153 brought from last year's account, has been appropriated in the following manner, viz., paid to the city fund in aid of rates, £10,000; placed to reserve fund, £7,965 8s. 1d.; total, £17,965 8s. 1d. In consequence of the great and increasing demand made upon the committee for the supply of electric current it is imperative that further extensions of plant and mains be carried out as speedily as possible, and it has been decided to lay mains in the following streets, viz, Wilmslow Road to city boundary, Plymouth Grove, Stockport Road to city boundary, Hyde road to Fenton street, Clowes street, Oldham road to Ten Acres Lane, Cheetham Hill Road to Cheetham Town Hall, Bury New Road to city boundary. To carry out these extensions further borrowing powers will be required.

At its meeting on Wednesday the City Council were to consider a proposal to reduce the price of electric current from 6d. to 5d. per unit, and the fixed charge to long-hour consumers from £9 to £7 per annum per unit of demand.

Onchan (I.O.M.).—The electric light installation at Onchan, near Douglas, Isle-of-Man, in celebration of the Queen's reign, is approaching completion, and will be formally opened on the 12th inst.

Portsmouth.—The Corporation want a foreman for work on street mains, who has had experience with transformers and arc lamps. See our "Official Notices."

Sheffield.—The Parliamentary Committee has passed the following resolution unanimously:—"That further negotiations with the Sheffield Electric Light and Power Company be suspended until it is ascertained by legal decision upon the action already commenced what really is the position of the Corporation in the matter."

St. Pancras.—On the recommendation of the chief electrical engineer, the Vestry has decided that whilst the ground is open for laying the arc circuits test wires shall be connected to the feeding mains from the King's Road station for the purpose of gauging the actual pressure at the distant ends of the feeders. The estimated cost is £275.

Tynemouth.—There is every indication, says the *Newcastle Daily Journal*, that the electric light will soon be an established fact in the borough of Tynemouth. The Town Council are anxious to avail themselves of the provisional order of the Board of Trade, and as the period of expiration is near at hand, they are now engaged in drawing up a practical scheme for working the new illuminant. At present the Corporation have a good deal of electrical plant lying idle in the market, and it is desirable that this should be utilised in the enterprise. The tramway company favour the substitution of electric-motive power for that of steam, which is now in use, and the Council think that if an arrangement can be made for the corporate authority to supply the company with electricity, it would go some way towards securing a good return on outlay incurred in providing the borough with the light. An electrical engineer has been retained, and he will soon place a full report on the question before the Council.

Wednesbury.—The Town Council has received a notification of the intention of certain firms to lay down private electric lighting in the town. The notices come from the Midland Electric Corporation For Power Distribution, and the South Staffordshire Blast Furnaces Power Syndicate.

Worthing.—The Electric Light Committee recommends the Council to apply for an extension of time under its provisional order.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Brierley Hill.—The Tramways Committee has presented a report on a visit made to the Isle of Man to inspect the electric tramways. The committee expressed the opinion that if satisfactory arrangements could be made with the British Electric Traction Company, it was desirable that electric traction should be substituted for the present system of steam traction on the local tramways. The Council adopted the report.

Bristol.—Notice and plans having been received by the County Council from the Bristol Tramways and Carriage Company of their application to the Light Railway Commissioners for powers to construct a new line under the Light Railways Act from St. George to Hanham, the proposal was favourably reported on by the chairman of the Highways Committee. The County Council has now approved of the construction of the line.

Leeds. — The Tramways Committee recommend the appointment of Mr. J. Kidd as chief engineer at the tramways electrical generating station at Crown Point. Mr. J. Burbridge is recommended as chief electrical engineer to the Tramways Department at £300 per annum.

Dover.—The Town Council last week decided to make the following engagements in connection with the electric tramways. The offices of the tramways are at the Town Hall:

			£	s.	d.
1 General Manager	at about	50s. per week	2	10	0
5 Drivers	" "	25s. "	6	5	0
5 Conductors	" "	15s. "	3	15	0
1 Electric Fitter	" "	45s. "	2	5	0
1 Permanent Way Man	" "	23s. "	1	8	0
1 Clerk	" "	20s. "	1	0	0
2 Men for Trailers or as Car Washers	" "	21s. "	2	2	0
			£19	0	0

Dundalk.—The *Freeman's Journal* says that the popular seaside resort of Blackrock will shortly be connected with Dundalk by an electric tramway, which will be run from the junction station of the Great Northern Railway Company, and will therefore afford direct communication with northern, southern, and inland towns. The promoters of the scheme are the Irish Development Syndicate Company, and their project not only embraces a tramway from the railway station to Blackrock, but also a branch line running down the main streets of the town to suit local traffic. The company have got the sanction of the Privy Council to the scheme, and they have also obtained the necessary way leave from the Dundalk Town Commissioners and County Louth Grand Jury. The line will be about 5 miles in length, and will be on the overhead trolley system. In connection with the tramway scheme there is an electric lighting project for the town. The Dundalk Town Commissioners have obtained a provisional order for the purpose, and have handed it over to the Development Syndicate on the following conditions, namely:—That the syndicate pay the cost of obtaining same, and in consideration of receiving practically free way leave for the tramways, that they undertake to light the town with electricity in a much more efficient manner than it is at present lighted with gas, at less cost.

Glasgow.—After going into the question of the equipment of the Springburn section with the electric trolley, as already voted by the Council, the Electricity Committee have reported to the Council recommending that the current should be taken from the electric lighting station and thus benefit that undertaking. But the Tramways Committee brought up a counter-resolution recommending that nothing of the sort be done, but that the special power plant and station be put down for the purpose of the tramways so as to give the trolley system a fair trial. Mr. John Young, tramway manager, in a memorandum to the Tramways Committee, says:—"It seems to me your course is quite clear—viz., to begin as authorised by the Corporation, with a clean sheet, and put down the very best and most up-to-date installation you possibly can, on your own accounts. In this way, and not by the use of obsolete machinery under the control of another department, will you know exactly what the work is costing as you go along, and acquire the definite knowledge necessary to guide you in making plans for the future of your great undertaking. Mr. Clark had the valuable opportunity of seeing last year, along with myself, the best electric installations in Europe and America, and I am confident he will undertake the engineering of the equipment of Springburn route on the overhead system, and that we can make it a model of its kind. All we require is a thoroughly practical young electrical engineer, at a salary of, say, from £200 to £250 a year, to act under Mr. Clark." The subject has of course made as usual an excellent subject for leading and other articles in all the Glasgow papers, accusing the Tramway Committee in one instance of making "a grievous blunder," and in others of indiscretion. It is very necessary now that the Corporation has at last decided to equip a section of its tramways with the trolley, the experiment should not be embarrassed or hampered in any way, but that the Tramway Committee should start as Mr. Young says with an entirely "clean sheet." The majority of the members of the Corporation appear to have appreciated this point for the Tramways Committee's recommendation was last week adopted by 43 votes to 17. It now remains for the Tramways Department to do its level best to bring the trolley system into greater favour with the Corporation by making the Springburn line a great success.

The Wheel of Fortune Defies the Motor Car.—The following comments, taken from an American street railway contemporary, are applicable to this country as well as across the water, though in a lesser degree. We suppose the cycle has not much affected the earnings of English electric tramways to any large extent, so far, and we are pretty sure the motor car hasn't:—"Bicycles, not motor cars, are cutting a large figure in street railway earnings. The effect last year was distinctly noticeable, and the wheel season opens with greatly augmented numbers. The wheel as a means of daily transportation between home and office or shop is daily increasing, and to all appearances is destined to increase. As the number of riders grows larger the demand for smooth paving on arterial lines will gather strength, and it really looks as though wheelers were likely to get about all they ask. The effect of bicycles on pleasure riding in all our large cities is startling, and we may well ask, where is it going to end?"

Torquay.—The Town Council referred the question of the proposed electric tramway from Torquay to Paignton to the burgesses, and the latter held their meeting last week when the chorus of opposition was very strong. The Great Western Railway will also oppose the scheme. A Plymouth paper says that if the meeting did not witness the burial of the scheme its funeral is not far off.

LONDON, S.W.
10462

TELEGRAPH AND TELEPHONE NOTES.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1895 ...	...
West Indies—		
Puerto Plata-Martinique	Dec. 19th, 1895 ...	...
St. Croix-Trinidad ...	Nov. 30th, 1896 ...	...
Grenada-Trinidad ...	June 2nd, 1897 ...	July 6th, 1897.
Amazon Company's cable—		
Parintins-Itacatiara ...	May 5th, 1896 ...	...
Obidos-Parintins ...	Dec. 7th, 1896 ...	...
Hong Kong-Amoy	June 24th, 1897 ...	July 8th, 1897.
Foochow-Shanghai	June 24th, 1897 ...	...
Bonny-Cameroon	June 25th, 1897 ...	...
Emden-Vigo	July 6th, 1897 ...	July 6th, 1897.
Landlines.		
Trans-Continental line beyond Mazol	March 12th, 1896 ...	...
Carthagena - Barranquilla (Columbia)	July 4th, 1896 ...	...
Siberian lines—		
Irkutsk-Werkhne-Oudinsk	July 3rd, 1897 ...	...
Saigon-Bangkok ...	July 4th, 1897 ...	July 5th, 1897.

April 19th, 1897.—Chio-Syra route impracticable.

April 19th, 1897.—During war between Turkey and Greece, cable between Trieste and Corfu cannot be used for messages for Turkey; they must be sent *vid* Bosnia, Montenegro and Servia.

The Ottoman Government announces that messages in secret language may not be sent to the Greek Minister and Consul in Turkey. They are to be sent in plain language.

April 21st, 1897. — The Greek Administration prohibits secret language for private telegrams for Greece.

April 25th, 1897.—The Hellenic Administration notifies delay on press messages emanating from Greek provinces by reason of the lines being blocked.

May 26th, 1897.—The Ottoman Administration notifies that, until further notice, private telegrams for Crete must be written only in plain Turkish or French language.

June 30th, 1897.—The Hungarian Administration requests us to notify that the regulations and tariffs agreed upon at Budapest came into force on July 1st, 1897. All Governments have now, excepting a few, approved them. There is no doubt, however, that they will all signify their approval of the regulations.

July 6th, 1897.—Communication between Olehleh (Sumatra) and Sabang (Weh) now open for International service.

The repairing of the Hong Kong-Amoy cable restores communication with Amoy, Shanghai, Corea, and Japan, *vid* India. There is still considerable delay by the Great Northern route.

Fast Speed Telegraphy.—We are reluctant to withhold honour from those to whom it is due, particularly from a public department, and more particularly from the Post Office. We believe the Post Office is blamed for a good many things that it has not done, and is sometimes criticised in a loving manner for what it ought not to have done, but is unfortunately guilty of. We have even heard it hinted that the Post Office is now and again not quite as punctual as is to be desired, but then the Post Office is a great institution, and we know of old that great things move slowly. We have heard it said, also, that the Post Office is often over-charging, but from another quarter comes the complaint that the Post Office chimney is every day discharging so much smoke and steam over the outer wrappings and clean linen of pedestrians in the St. Martin's-le-Grand district as to make life intolerable for a short time. But these are minor matters. The punctuality of every other department is surely put to shame when compared with that of the Telegraphs Department. We recorded last week that on the occasion of the great International Chess Match messages travelled from London to Washington and back (8,360 miles) in 13·25 seconds. But the Post Office, like other creatures of the earth, must be allowed to go in for record breaking sometimes. This time it has won with a vengeance. A Wimbledon resident handed in a message at 12.30 p.m.; this was received at Twickenham at 2.53 and delivered at about 3.15. As fate would have it, the sender was informing his friends that he would be home to lunch at 2 o'clock! It could have been sent without wires nearly as quickly. But this is nothing, a telegram was sent from the City addressed to the suburbs on June 12th, and the addressees are still waiting for it to turn up! This wants some beating, even by that very perfect system the London telephone service, which we all love so dearly.

The Telephone Service.—It is understood that a dead set will be made at the salary of the Postmaster-General when the Post Office Estimates are reached in the Commons, in order to draw attention to the inefficiency of the telephone service in the metropolis.

The Telephone in South Africa.—Writing on June 14th, a Pietermaritzburg correspondent said: The Government has purchased the City Telephone Company's business for £3,650 and proposes spending another £3,000 in improvements."

Telegraph Extensions.—In the House of Commons the other day, replying to Mr. Weir, Mr. Hanbury said the sum of £18,000 would be available for any extensions in the Highlands for which guarantees might be forthcoming, and extensions on guarantees would, of course, be granted in the Highlands and Islands of Scotland as elsewhere on the easier terms announced by the Chancellor of the Exchequer in this year's Budget.

CONTRACTS OPEN AND CLOSED.

OPEN.

Birkenhead.—July 20th. The Corporation wants tenders for the wiring and lighting by electricity of the Woodside Ferry.

Dundee.—July 13th. The Gas Commissioners want tenders for a supply of copper strip. City Electrical Engineer, Mr. W. H. Tittensor.

France.—July 13th. Tenders are being invited by the French Post and Telegraph Authorities in Paris for the supply of 755 kilometres of paper-insulated electric cables in 16 lots. Tenders to be sent to the Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

Halifax.—July 14th. Tenders are invited for the supply of 91 side and centre poles for electric wires, for the Tramways Committee of the Corporation. Particulars, &c., on application to Mr. Edward R. S. Escott, C.E., Borough Engineer, Town Hall, Halifax.

Hammersmith.—July 21st. The Vestry wants tenders for electricity supply stores. Tenders to be delivered personally by contractors at the Vestry meeting on July 21st. See our "Official Notices."

Hull.—July 29th. The Electric Lighting Committee want tenders for the supply, erection and hiring of certain plant and machinery required in connection with the electric lighting installation during the winter of 1897-8. Borough Electrical Engineer, Mr. A. S. Barnard. See our "Official Notices."

Lincoln.—July 14th. Tenders are being invited for the supply and erection of two dry back marine-type boilers: high-speed engines, continuous current dynamos, steam and other pipes, pumps, motors, and travelling crane; a fuel economiser: storage batteries; a main switchboard and instruments; armoured concentric and triple-concentric cables, and pilot wire cables. Particulars may be obtained at the office of Mr. C. S. Vesey Brown, city electrical engineer, Corporation Offices, Silver Street, Lincoln.

Newport.—July 30th. The Electric Lighting Committee invite tenders for the supply and erection of boilers, mechanical stokers, and other apparatus for the boiler house plant, steam alternators and exciters, accumulators, steam and exhaust pipes, switch gear, arc lamps, posts, &c., coal elevator and "allowance for day-load plant." Consulting Engineer, Mr. Robert Hammond. See our "Official Notices."

Roumania.—August 20th. Tenders are being invited by the General Direction of the Roumanian Posts and Telegraphs in Bucharest for the supply of 55,000 porcelain (double-bell) insulators. Tenders to be directed to the Direction Générale des Postes et des Telegraphes, Bucharest.

Sofia.—September 22nd. The Secretary of State for Foreign Affairs has received a despatch from the Acting British Consul-General at Sofia, stating that the municipality of that town invite tenders for—(1) The supply of electric currents to light the streets as well as public and private buildings in the town and the supply of electric power; and (2) The construction and working of electric tramways in the town and suburbs. Tenders will be received at the offices of the municipality of Sofia. Such further particulars as have been received may be seen at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 6 p.m.

Spain. — July 12th. The General Direction of the Spanish Posts and Telegraphs in Madrid is inviting tenders for the supply of 20,000 sheet zinc cylinders. Tenders to La Direccion General des Postes y Telegrafos, Madrid.

Spain.—August 5th. Tenders are being invited by the General Direction of the Spanish Posts and Telegraphs for the supply of 14 tons of copper sulphate for the telegraph service. Tenders to the Direccion General de Correos y Telegrafos, Madrid.

St. Helens.—July 20th. The Corporation want tenders for the supply and erection of plant and machinery for electric lighting extensions, including boiler, pump, economiser, alternators, exciters, switchboard, underground work, transformer sub-stations, &c. Consulting engineer, Mr. Robert Hammond.

CLOSED.

Belfast.—The tender of Messrs. J. & W. Stewart for the erection of the electric lighting station buildings, was the lowest, and has been accepted.

The Corporation last week accepted the tender of Messrs. J. H. Holmes & Co. for the switchboard required for the new station; that of Messrs. Coates & Co. (Limited) for the supply and fitting of mechanical stokers; that of Messrs. Crompton for motor, generators, and boosters; also that of Messrs. Edison & Swan (United Electric Light Company, Limited) for arc lamps.

Southampton.—The following tenders were received by the Electric Lighting Committee for the supply of boilers, mechanical stokers, &c., for the new generating station:—

	£ s. d.
C. S. Mallett & Co., London	7,353 15 0
Babcock & Wilcox	7,748 0 0
Yates & Thom, Blackburn	8,340 0

THE GUTTA-PERCHA CORPORATION, LIMITED.

We have before us a copy of the proposed prospectus of this company, which, with a capital of £350,000, divided into 80,000 7 per cent. preference shares of £1 each, and 270,000 ordinary shares of the same value, has been formed to trade in and manufacture gutta-percha, and to acquire and work the patents of MM. Serullas and Hourant for a process to obtain the gum from the leaves and twigs of gutta-percha trees in an efficient and economical manner by means of a chemical solvent. The following claims are made to show the great value of the Serullas process:—

The leaves can be gathered from shoots and small trees of 5 years and upwards.

The leaves and twigs collected from a full grown tree would, it is estimated, average about 40 ozs. of pure G.P. per annum.

By the methods adopted by the natives, the yield is extremely small, many experts stating it at not more than a few ounces of fairly good gutta from each tree cut down.

As the gutta-percha tree only gives seed at 30 years, the natives, by destroying the trees at a much earlier age, prevent their reproduction.

Then follow extracts from the reports of Lord Kelvin and Dr. John Hopkinson, which go to show that the insulation resistance of the Serullas gum is vastly superior to that hitherto realised by G.P. or I.R., and that its specific inductive capacity is lower.

It is a little unfortunate that the results obtained by these experts do not quite agree, for although the Glasgow and London tests were made with core of the same diameter of copper and G.P., and practically the same lengths, about 70 to 75 yards, Lord Kelvin gives 2·95 as the specific inductive capacity, whereas Dr. Hopkinson makes it 3·12. Still, when one considers the very short lengths tested and the influence the ends have upon the whole, the experiments coincide in all other respects fairly well. To us, however, laboratory tests such as these have no particular value, as many gums can be so manipulated in course of manufacture as to give almost any electrical result desired, excepting perhaps very low capacity.

Most important, and from the chemical point of view, is the very exhaustive report of Prof. Ramsay, who finds the product to be identical with ordinary G.P., the only difference being in favour of the quality of the new gum, so assuming that the material, electrically and chemically, is in all respects equal to that which has done service for so many years, and that its durability is also assured, we will glance at the commercial aspect of the concern.

The patents to be acquired are those of Serullas and Hourant (so far as they apply to gutta-percha) for Great Britain, Nos. 11,166 of 1892, and 654 of 1896, France, Germany, Belgium and the United States, together with patent rights for all other countries excepting Brazil.

It is intended to provide works and plant in the United Kingdom for the treatment of the leaves and twigs to be imported, the corporation already possessing a stock of 160 tons of dried leaves, and on an output of 300 tons per annum, the profits are estimated as follows:—

300 tons of gutta at 4s. 6d. per lb.		£151,200
Cost of production at 2s. per lb.		67,200
Gross profit on a year's production		£84,000
Deducting the amount required to pay a dividend of 7 per cent. on the 80,000 preference shares, viz.	£5,600	
And a like dividend of 7 per cent. on the 270,000 ordinary shares, viz.	18,900	
		24,500
There remains a surplus net profit per annum of		£59,500

Being sufficient, after making liberal allowance for administration expenses and for the formation of a reserve fund, to increase the dividends on both classes of shares to a total of at least 20 per cent. per annum.

This estimate is exclusive of royalties or other profits to accrue to the corporation from the working of their patents or patent rights in other countries, and it is expected that considerable profit will also be derived by removing vegetable impurities from ordinary G.P.

The vendor, who has undertaken to bear all preliminary expenses up to allotment, and who makes a profit on re-sale, has fixed the purchase consideration at £290,000, payable as to £20,000 in cash, £90,000 in fully paid ordinary shares, and the balance of £180,000 in cash or fully paid ordinary shares at the discretion of the corporation.

These financial arrangements permit of the provision of £60,000 for working capital, an amount considered ample for all purposes.

In our opinion the purchase consideration is as much too high as the working capital is too low. It must be borne in mind that the corporation does not possess any monopoly in the gutta-percha industry, it stands simply in the position of a competitor for business in the open market; we do not see any reason why other processes for obtaining the gum should not be soon forthcoming, as the two patents acquired by the corporation do not seem to be master patents (one, indeed, requiring amendment) but simply claim a special mode of treatment, and there is nothing to prevent anybody who feels inclined from buying up gutta-percha twigs and leaves and so bringing about a "corner."

And when we read that it is proposed to provide works and plant to treat 400 to 500 tons per annum, and that the cost of production for 300 tons only is £67,000, the sum set aside for working capital seems quite inadequate; therefore we are strongly of opinion that before the shares of the corporation are offered to the public there is need of considerable modification in the proportion which the purchase money bears to working capital. With Lord Kelvin and Dr. Bottomley as consulting electricians, Profs. Ramsay and Serullas as consulting chemists, and Sir Samuel Canning as engineer, the corporation is splendidly equipped technically speaking; but the commercial element seems weak, and as the prospectus is one not specially attractive to the public, it is to be hoped that the directors will see their way to reconsider these points, unless the shares are likely to be privately taken up. The unworked process may be, and probably is, an exceedingly good one; but, on the terms of the prospectus, we could not conscientiously recommend the company to investors.

NOTES.

The Sir John Pender Memorial.—Last Friday afternoon a meeting was held under the presidency of the Marquis of Tweeddale, at the University College, for the purpose of inaugurating the memorial to the late Sir John Pender, as announced in our last issue. Among those present were the Marchioness of Tweeddale, Lord Kelvin, Sir James and Lady Pender, Mr. and Mrs. J. Denison Pender, and Dr. Muirhead. The chairman, in handing over the cheque for £5,000 to endow the electrical laboratory at the College, referred to the history of the memorial fund and its object. A sum had been expended upon the bust of Sir John, and the remainder of the amount subscribed would be given to the Glasgow University and the West of Scotland Technical Institute. Mr. Haldane, Q.C., M.P. (vice-president), thanked the chairman on behalf of the council for the cheque, and Dr. Fleming, professor of electrical engineering at the college, also thanked the committee for placing the college in a position to give practical demonstrations of electrical science in well-equipped laboratories. Lord Kelvin expressed his hearty concurrence with the resolutions of the Pender Memorial Committee, as to the mode in which the fund collected should be distributed. His lordship referred to Sir John's connection with the Atlantic cable, and in conclusion suggested that the bust of Sir John Pender should be placed in some conspicuous position where it might be viewed by all. The laboratories at the college were afterwards thrown open to those present for inspection.

Special for Visitors to the Toronto B.A. Meeting.—The secretary of the Institution of Electrical Engineers asks us to give place to the following copy of a communication he has received from the secretary of the American Institute:—

American Institute of Electrical Engineers,
New York, *June 25th*, 1897.

F. H. Webb, Esq.,
Secretary, Institution of Electrical Engineers,
London, England.

Sir,—As it seems quite possible that several of your members are likely to visit America on the occasion of the meeting of the British Association, I have been directed by the Council to extend to the Institution a general invitation to its members to attend the general meeting of the Institute, which is to be held at Greenacre-on-the-Piscataqua River, near Portsmouth, N.H., July 26th—28th.

Yours truly,
(Signed) Ralph W. Pope, *Secretary*.

Tramway Operating Expenses.—The *Street Railway Review* gives the following information as to the operating expenses of the Calumet Electric Railway, Chicago. The company operates 75 miles of track, all of it double except one mile. The number of cars in use varies from 37 in winter to 200 in summer. There are practically no grades on the line. The distance from the power-house to the farthest terminal is 5½ miles. The coal used costs from $1.15 to $1.50 per ton. This road began operating in 1891, and has constantly extended its lines, having 10 miles in 1892, 23 miles in 1893, 53 miles in 1895, and 70 miles in 1896. John Mac Fayden, general superintendent of the Chester Traction Company, Chester, Pa., says that on that road the operating expenses for the year 1896 averaged $·0759 per car mile. The company operates 28 miles of track, only two of which are double track; at the extreme end of one division, which is 8 miles from the power-house, is a 6 per cent. grade 1,500 feet long; there are several other grades of from 8 to 10 per cent.; the average number of cars operated is 28 per day.

The Engineering Crisis.—The *Standard* of yesterday states that there was no change in the situation on Wednesday. No positive action will be taken till Monday or Tuesday next week, but both sides are now quite prepared for the inevitable struggle which will then begin. The notices posted on Tuesday by the federated employers affect from 28,000 to 30,000 men, and the remainder, with the labourers who will perforce be rendered idle, will reach to a total of 115,000 men. The men not under notice will, as already stated, cease work with the 25 per cent. to whom the employers have issued notices. There was one hopeful indication on Wednesday in the fact that the officials of the Steam Engine Makers' Society, the second largest union now represented on the joint committee, had decided not to withdraw the remaining 75 per cent. of their members from shops where 25 per cent. are to be locked out. The lamentable results of the strike may not be very apparent to everyone; but even if matters were now to resume their former position, injury to the engineering trades has already been done. Take, for instance, the Colonial or foreign buyer; directly he hears that a strike or lock out is a possibility in this country, does he not at once divert his orders for machinery, &c., to that country from which he feels confident he will obtain prompt delivery, and once having gone elsewhere, may his orders ever come back?

Electric Power for Surface Pumping.—Mr. Edmund Howl, general manager, in a report he has submitted to the South Staffordshire Mines Drainage Commissioners, makes a very important suggestion respecting the use of electric power. He states that he has, along with Mr. Marten, the engineer, gone extensively into the question of using electric power for surface pumping from low lying ground, and has fixed on 33 places in the drainage area where small electric stations could be placed with advantage. The cost of pumping on the surface, he states, is not more than 5 per cent. of the cost of pumping from below, as surface water would not have to be raised more than 15 feet into the streams, as against an average of 400 feet when pumped from the mines. If surface pumping could be established, which would prevent three to four million gallons per day from getting below during the winter months, it would save the cost of working the auxiliary engines, and also pushing the main engines to an economical extent, and would effect a saving on revenue account, in a wet season similar to last, of about £3,000 per annum. He called special attention to the subject now, as an Electric Power Distribution Company have deposited statutory notices with a view to supplying electricity for power purposes over an area which embraces the whole of the Tipton Mines Drainage area.

The Rebate System.—The County of London and Brush Provincial Electric Lighting Company, Limited, announce that they have adopted the demand indicator system of charging for energy, and that the following reduced scale of prices will come into effect as from July 1st:—

For lighting purposes, for the first two hours' daily use of the maximum demand	7d. per unit.
And for all current in excess of such two hours' average daily consumption	3d. „
For power purposes (when taken from the company's direct current power mains at 500 volts) for the first one hour's average daily consumption of the maximum demand	6d. „
And for all current in excess of the first one hour's consumption	2d. „

Personal.—Mr. H. J. Spencer announces that he has resigned his appointment as engineer in charge to the Leyton Council, and has rejoined the staff of Mr. Warden-Stevens, consulting engineer.

Obituary.—In recording the death of Mr. Henry Dever, of Messrs. Deloitte, Dever, Griffiths & Co., the well-known accountants, the *City Press* says that Mr. Dever was closely identified with the inception of the great cable-laying undertakings, associating himself with the late Sir John Pender, Mr. Cyrus Field, Sir James Anderson, and Sir D. Gooch, who were the pioneers of the electric cable. He was called upon to advise the large telegraph companies of America in the financial aspects of their enterprises.

Municipal Electrical Association.—On Saturday morning the business meeting of the Municipal Electrical Association was held at the Manchester Electricity Works. After considering the report of the sub-committee's and the secretary's report and treasurer's statement, the meeting considered the constitution of the Association, and resolved to form a new class, to be called "Associate Members," consisting of the chief assistant electrical engineers of large stations, such members to have equal rights with full members. The Association also resolved to increase the Council by adding two members, being chairmen of Electric Lighting Committees. The place of meeting for the next Convention was then discussed, and Glasgow was selected. Mr. W. Arnot, of Glasgow, was unanimously elected president. The two retiring members of committee, Mr. H. Faraday Proctor, of Bristol, and Mr. T. P. Wilmshurst, of Halifax, were elected vice-presidents. The following gentlemen were then elected members of the Council for the ensuing year:—Mr. E. T. Ruthven Murray, Worcester; Mr. A. Bromley Holmes, Liverpool; Mr. Albert Gay, Islington; Alderman Lloyd Higginbottom, Manchester; Councillor George Pearson, Bristol. Mr. C. H. Cottam, the retiring hon. treasurer, was re-elected, and Mr. A. B. Mountain was also re-elected hon. secretary.

Appointments Vacant.—An assistant lecturer in physics and electrical engineering is wanted for the Royal Technical Institute at Salford. Salary £120 per annum. See our "Official Notices."

Glasgow Corporation want an electrical engineer to act as assistant to the tramways engineer in equipping and working the Springburn route of tramways on the trolley system. See our "Official Notices."

The Worcester Corporation want an engineer-in-charge at the electricity works. Salary, £135 per annum. Applications to be lodged by July 17th. See our "Official Notices."

The Colonial Premiers and Cable Matters.—The reason for the cancelling of the proposed visit of the Colonial Premiers to the works of the Telegraph Construction and Maintenance Company, which was announced for Wednesday, July 7th, is that the Premiers last week unexpectedly received the Queen's command to attend at Windsor Castle. It was found impossible to arrange another date for the visit to Greenwich.

Correction.—Mr. Jno. F. Snell, in our Correspondence columns, corrects the statement on which we commented in respect of the reduction to 250° of the gases from the water tube boiler which Mr. Snell was, by a misprint in the copy of his paper, reported to have claimed. What he really wrote was 350°, and we are sorry that the copy of his paper sent to us contained the non-corrected 250°. To claim the reduction to 350° is not so extravagant. It is the temperature corresponding to a boiler pressure of 125 lbs. Now, even this temperature is much below what can be expected from a boiler carrying steam even as low as 100 lbs., and unless the boilers referred to are comparatively low pressure boilers, it can hardly be claimed that this low temperature has not been secured by very great leakage of air into the flues through the brickwork. A large economiser of Green's type is fully equal to any water tube boiler as a heat absorbent, yet 350° is not looked on as a high temperature for the exit gases of an economiser fed with cold water and receiving only gases that have already passed through a steam boiler. We are exceedingly sorry that we have criticised Mr. Snell upon erroneous data. We did but take the figures as supplied to us. Even when given with every good intention, we are inclined to doubt flue temperature records unless taken with a thermometer. When too high for the thermometer, and a pyrometer is employed, readings are most doubtful and uncertain.

Telegraphy Without Wires.—On Monday Marconi's experiments in telegraphy without wires were renewed at the Ministry of Marine at Rome before a number of journalists. On Tuesday Signor Marconi was to exhibit his apparatus before the King and Queen of Italy, and afterwards to proceed to Spezzia, and transmit messages between different ships intercepted by other vessels.

Presentation.—We recently announced the retirement of Mr. W. Geipel from his position as superintending engineer to the Brush Electrical Engineering Company. On the 30th ult. a number of his colleagues and associates presented him with two handsome clocks, accompanied by a cordial expression of the good feeling and respect which he has inspired among his co-workers during his long term of service, in various responsible positions, with the Brush Company.

Electrolysis in the Formation of Organic Compounds.—F. B. Ahrens has recently decribed an attempt to reduce nitriles electrolytically to amines, in accordance with the equation $R . CN + 2 H_2 = R . CH_2 . NH_2$, which represents the usual mode of reduction by sodium amalgam or sodium and alcohol. It was found that in acid solution there occurred, together with the reduction of the nitrile, a saponification of it, with formation of acid, in accordance with the equation:—

$$R . CN + 2 H_2O = RCOOH_4 + NH_3.$$

The lower the molecular weight of the nitrile, the larger was the proportion of ammonia produced. Acetonitrile yielded only ammonia; propionitrile a fair proportion of n-propylamine, in addition to ammonia; and benzonitrile yielded only benzylamine. After electrolysis the solution was treated with ether, to extract any unaltered nitrile; it was then made alkaline with soda, and the bases were driven off with steam. The distillate was neutralised with hydrochloric acid, evaporated down, and the salt extracted with absolute alcohol. Sal-ammoniac remained behind, while the hydrochloride of the amine went into solution, and was identified as chloroplatinate. Attempts to reduce nitriles electrolytically in alkaline solution were less successful, for practically nothing but ammonia was obtained.

The Extraction of Mercury, Arsenic and Antimony from their Ores.—The sulphides of the metals mercury, arsenic and antimony, are well known to form double compounds with the sulphides and sulphydrates of the alkaline earths. Messrs. Siemens took advantage of this fact, and upon it based their process for extracting from the sulphides, sulphur, and the corresponding metal, without the formation of useless by-products. For example, when a solution of antimony sulphide in calcium sulphydrate is electrolysed, antimony separates out at the cathode and calcium sulphide at the anode; no diaphragm is needed. By treatment with carbon dioxide in the presence of water, the calcium sulphide is converted into sulphuretted hydrogen, calcium carbonate, and sulphur. When the mixture of the last two is heated in the absence of air, sulphur and carbon dioxide are evolved. The sulphur is condensed, and the carbon dioxide is utilised for treating a further quantity of calcium sulphide. The lime which is left behind after the heating is converted into calcium sulphydrate by the sulphuretted hydrogen obtained in the second operation. This subject was discussed recently in *L'Eclairage Electrique*, page 276.

Silver Medal.—The Council of the Society of Arts has awarded the silver medal of the Society to Mr. W. B. Esson for his paper on "The Transmission of Power by Alternating Currents," read in March last, and subsequently published in the Electrical Review. Mr. Esson has our congratulations.

The New Journalism.—An esteemed contemporary has apparently engaged the services of a Society journalist for describing social events, which seem now-a-days to possess far greater importance than such trivial matters, as, say, the strike in the engineering trades. For downright rodomontade that garden party scene, written apparently days before the event, beggars all description.

Accident.—An electric car while crossing a swing bridge at Bay City, Michigan, on Wednesday, fell with seven passengers into the Saginan River. A woman and three children were drowned.

Electric Shock Fatality.—We learn that while a man named James Morris was effecting some repairs at the electric light station buildings, Bournemouth, on Tuesday afternoon, he received a 2,000-volt shock, and was killed immediately.

NEW COMPANIES REGISTERED.

The North British Electricity Supply Company, Limited (3,555).—Registered at Edinburgh, June 29th, with capital of £1,000 in £1 shares, to carry on in Gonrock, Port Glasgow, Greenock, and other places, the business of electric lighting in all its branches. The subscribers (with one share each) are:—R. Sand, 5, Newark Street, Greenock, engineer; J. Reid, Monfode, Greenock, worsted spinner; A. Lyle, 105, Fuivart Street, Greenock, shipowner; C. Ramsay, 49, Octavia Terrace, Greenock, merchant; L. Walker, Greenock, chartered accountant; W. McClure, Greenock, solicitor; J. Bilsland, 45, Hyde Park Street, Glasgow, baker. The directors to be afterwards appointed; no qualification given. Registered office, 82, West Nile Street, Glasgow. Registered by Oswald & Son, agents, Edinburgh.

Peterborough Electric Light and Power Company, Limited (53,119).—Registered June 28th with capital of £10,000 in £1 shares, to carry on the business of electrical engineers, electricians, contractors, and suppliers of electricity, and electric apparatus manufacturers. The subscribers (with one share each) are:—W. Clarabut, Market Place, Peterborough, draper; F. E. Gripper, 19, Gt. George Street, S.W., electrical engineer: J. C. Wigham, Albany House, Monkstown, Co. Dublin, electrician; G. W. Holden, Peterborough, outfitter; H. J. Read, Liverpool Road, St. Albans, engineer; R. W. Elsey, 2, North Street, Peterborough, engineer; W. T. Bressland, Westcott, near Dorking, engineer. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, one share; remuneration as fixed by the company. Registered by Clarkson & Toovey, 98, Great Tower Street, E.C.

Weymouth Electric Light and Power Company, Limited (53,120).—Registered June 28th with capital of £10,000, in £1 shares, to carry on the business of electrical engineers, electricians, contractors, electrical apparatus, manufacturers, and suppliers of electricity. The subscribers (with one share each) are:—J. Toovey, 98, Great Tower Street, E.C., solicitor; F. E. Gripper, 19, Great George Street, S.W., electrical engineer; J. C. Wigham, Monkstown, County Dublin, electrician; S. K. Thompson, 28, Millbank Street, S.W., electrician; H. J. Read, Liverpool Road, St. Albans, engineer; H. J. Butcher, 54, Lattimore Road, St. Albans, clerk; W. T. Pressland, Westcott, near Dorking, engineer. The number of directors is not to be less than three, nor more than seven; the subscribers are to appoint the first. Qualification one share; remuneration as fixed by the company. Registered by Clarkson & Toovey, 98, Great Tower Street, E.C.

Wycombe (Borough) Electric Light and Power Company, Limited (53,133),—Registered June 29th with capital £15,000 in £5 shares, to adopt a certain agreement to take over and exercise all the lighting powers conferred on the Corporation of Chepping Wycombe, Bucks, by the Electric Lighting Orders Confirmation (No. 1) Act, 1894, and to carry on the business of an electric light and power company. The subscribers (with one share each) are:—A. Slatter, 7, Ridgmount Street, Bedford Square, W.C., electrical engineer; B. Parry, 2, Sterndale Road, Brook Green, W., clerk; H. Stebbings, 34, Chryssell Road, Brixton, clerk; G. H. Hoyle, Parliament Mansions, Westminster, solicitor; F. E. Gripper, 19, Gt. George Street, S.W., electrical engineer; F. Payton, 19, Gt. George Street, S.W., clerk; L. A. Hards, 57, Grosvenor Road, Westminster, electrical engineer. The number of directors is not to be less than three nor more than six; the subscribers are to appoint the first; qualification £200; remuneration as fixed by the company. Registered office, 7, Ridgmount Street, Bedford Square, W.C.

Automatic Telephone Company, Limited (53,157).—Registered July 1st with capital of £100,000, in 5s. shares, to adopt certain agreements, and acquire the Apostoloff automatic telephone invention, and to carry on the business of a telephone, telegraph, and electric light, heat, and power supply company. The subscribers are: M. Margowski, 13 and 14, Abchurch Lane, E.C., 19,400 shares; Honduras Government Banking and Trading Company, Limited, 13 and 14, Abchurch Lane, E.C., 6,000 shares; M. J. Alexander, 16, Hatton Garden, E.C., merchant, 10 shares: J. D. Gibbs, The Mount, Goring-on-Thames, gentleman, 10 shares; Baron Cohen, 1, Piccadilly, W., gentleman, 10 shares; J. Mendelson, 56, Charlotte Street, W., gentleman, 10 shares; J. W. Cohen, 58, Angell Road, Brixton, gentleman, 200 shares; H. G. Sworn, 5, Highbury Crescent, N., physician, 800 shares. The number of directors is not to be less than two, nor more than five. The first are: M. Margowski, J. D. Gibbs, J. W. Cohen, M. H. Alexander, and H. G. Sworn; qualification, 1,000 shares; remuneration, 5 per cent. of the net profits divided. Registered office, 13 and 14, Abchurch Lane, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

India-Rubber, Gutta-Percha and Telegraph Works Company, Limited.—This company's annual return was filed on May 29th, when 50,000 shares were taken up out of a capital of £812,000 in £10 shares, and paid for in full.

House-to-House Electric Light Supply Company, Limited (25,913).—This company's annual return was filed on June 26th. The capital is £200,000 in £5 shares (27,900 ordinary, 12,000 preference, and 100 founders'); 11,661 ordinary, 10,000 preference, and 100 founders' shares are taken up, and 1,000 ordinary and 100 founders' shares are considered as paid. £5 per share has been called on 9,000 ordinary and 6,678 preference, and £3 per share on 1,661 ordinary and 3,322 preference. £91,530 has been paid, and £1,809 is in arrears.

West African Telegraph Company, Limited (21,626).—This company's annual return was filed on June 18th, when 23,109 shares were taken up out of a capital of £400,000 in £10 shares, and paid for in full.

Oswestry Electric Lighting and Power Company, Limited (38,303).—This company's annual return was filed on May 27th, when 4,191 shares were taken up out of a capital of £10,000 in £1 shares. The full amount per share has been called, and £4,376 10s. has been paid (including £312 5s. paid in advance of calls), and £126 15s. is in arrears.

CITY NOTES.

The Sunderland Accounts.

In the electric lighting accounts of the Sunderland Corporation for 1896, it will be seen that the works' costs have gone up ¼d. per unit, and that the gross profits are less than they were last year. In justice to the works, it should be explained that a motor alternating plant, which supplies the residential district, was not running during the first year; and as the efficiency of this plant has yet only reached 27 per cent., and as the load factor is, as yet, not 5 per cent., this additional plant is responsible for the extra coal per unit, and, to some extent, for a rise in the wages. The oil, stores, and water are much higher, because the trials of the new plant have been debited to the running costs. The repairs item is high, and is largely attributable to the fact that the maintenance of battery reached a figure of 7s. 8d. of the total sum spent on this item. The gross profits have been reduced largely, because the prices were reduced last September from 6d. to 5d., and from 3d. to 2½d. Then, again, it has to be remembered that the station had no one in charge for practically two months of last year, which, to some extent, must have interfered with the smooth running of the station. No doubt Mr. Snell will very soon not only have recovered lost ground, but have obtained marked improvements in the working of the station.

The following table gives the cost per unit:—

	1896.	1895.
Total capital expended	£39,341	£29,233
Number of units sold	146,440	95,446
Number of lamps connected	12,672	7,724
Revenue from sale of current	£2,497	£2,040
Net revenue	—	—
Average price obtained per unit	4·09d.	5·11d.

Cost of production.	£		Per unit.	1895.
Coal	304		·50d.	·42d.
Oil, waste, water and engine room stores	128		·21d.	·10d.
Salaries and wages at generating station	600		·98d.	·85d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	190	Works' cost 2·00d.	·31d.	·11d.
Rent, Rates and taxes	287		·47d.	·46d.
Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges, and insurance	482		·79d.	1·70d.
Depreciation of buildings and plant account	—		—	—
Renewal fund account	—		—	—
Total	£1,991		3·26d.	3·64d.

Revenue.	£	s.	d.	Average price obtained per unit.
By sale of current	2,497	0	0	4·09d.
Meter rents, &c.	217	0	0	—
Other items	—			—
Transfer Fees	—			—
Total	£2,714	0	0	4·09d.

Total cost per unit (exclusive of depreciation and renewal accounts), 3·26d.; works' cost, 2·00d.

Belfast Accounts.

Despite the fact that the cost of working at Belfast still rules high, considerable progress has been made both in the extension of electric lighting and in the lessening of running costs. The heavy cost of fuel is still a noticeable item, so we presume that the electricity department is still paying the same price for gas as an ordinary consumer does. Salaries and management show a considerable decrease in the cost per unit, and, altogether, considering the disabilities under which the system works, the results are fairly satisfactory.

The following table gives the cost per unit:—

	1896.	1895.
Total capital expended	£35,187	£29,343
Number of units sold	149,721	82,771
Number of lamps connected ...	14,750	10,500
Revenue from sale of current ...	£3,928	£2,178
Net revenue	£1,553	—
Average price obtained per unit ...	6·30d.	6·31d.

Cost of Production.	£		Per unit.	1895.
Coal	831		1·33d.	1·45d.
Oil, waste, water, and engine room stores	121		·19d.	·23d.
Salaries and wages at generating station	543		·87d.	1·29d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	330	Works' cost 2·92d.	·53d.	·49d.
Rent, rates and taxes	213		·34d.	·68d.
Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges, and insurance	448		·72d.	1·28d.
Depreciation of buildings and plant account	—		—	—
Renewal fund account	—		—	—
Total	£2,504		3·98d.	5·42d.

Revenue.	£	s.	d.	Average price obtained per unit.
By sale of current	3,928	0	0	6·30d.
Meter rents, &c.	129	0	0	—
Supply of steam	—			—
Transfer fees	—			—
Total	£4,057	0	0	6·30d.

Total cost per unit (exclusive of depreciation and renewal accounts), 3·98d.; works' cost, 2·92d.

Wolverhampton Accounts.

Down to the period covered by the report which we are now considering, the municipal electrical undertaking at Wolverhampton has resulted in an annual loss, but it is interesting to record that this state of affairs has been so much improved upon during the year ending March 25th, 1897, that after paying interest on loans (£969), contribution to sinking fund (£851), repayment on account of £5,000 (£137), and a sum of £176 for bankers' interest, there remains a balance of £225, which is to be devoted to wiping off the deficit of previous years. There can be no question that the Corporation Electricity Works are now in a very sound position, and with the extensive extensions now being made they will very shortly occupy a strong financial position.

The following table gives the cost per unit:—

	1896.	1895.
Total capital expended	£38,216	£34,639
Number of units sold	224,709	—
Number of lamps connected	—	—
Revenue from sale of current	£5,021	—
Net revenue	£2,359	—
Average price obtained per unit ...	5·3d.	—

Cost of Production.	£	s.	d.	Per unit
Coal	502	0	0	·53d.
Oil, waste, water, and engine room stores	199	0	0	·21d.
Salaries and wages at generating station	651	0	0	·69d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	410	0	0 (Works' cost 1·86d.)	·43d.
Rates and taxes	124	0	0	·13d.
Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges and insurance	658	0	0	·70d.
Depreciation of buildings and plant account	—			—
Renewal fund account	—			—
Total	£2,544	0	0	2·69d.

Revenue.	£	s.	d.	Average price obtained per unit.
By sale of current	5,021	0	0	5·3d.
Meter rents, &c.	92	0	0	—
Transfer fees	—			—
Total	£5,113	0	0	5·3d.

Total cost per unit (exclusive of depreciation and renewal accounts, 2·69d.; works' cost, 1·86d.

Elmore's German and Austro-Hungarian Metal Company, Limited.

An extraordinary general meeting of the shareholders of this company was held on Tuesday last at Winchester House, Old Broad Street, under the presidency of Mr. J. MacFarlan. The object of the meeting was to consider the following resolutions:—

"1. That the capital of the company be reduced from £250,000 divided into 50,000 preference shares of £2 each and 75,000 ordinary shares of £2 each to £162,981, divided into 50,000 preference shares of £2 each and 62,981 ordinary shares of £1 each, and that such reduction be effected by cancelling 1,682 ordinary shares which have been forfeited, and 10,337 ordinary shares which have been surrendered to or for the benefit of the company, and by cancelling paid-up capital to the amount of £1 per share upon each of the remaining 62,981 ordinary shares, and by reducing the nominal amount of the said ordinary shares from £2 to £1 each."

"2. That from and after the said reduction of capital has been confirmed by the Court, the rights attached to the preference and ordinary shares constituting the reduced capital of the company shall be as follows, that is to say:—Until December 31st, 1903, nine-tenths of the net profits of the company available for distribution as dividends in each year shall be applicable to the payment of a dividend for that year on the amounts paid up on the preference shares, and the remainder of such profits shall be applicable to the payment of a dividend for that year on the amounts paid up on the ordinary shares. After December 31st, 1903, the net profits of the company available for distribution as dividends in each year shall be applicable, first, to the payment of a preferential dividend of 7 per cent. for that year on the amounts paid up on the preference shares; secondly, in payment of a dividend of 20 per cent. for that year on the amounts paid up on the ordinary shares, and the surplus, if any, shall be divided between the holders of the preference and ordinary shares in proportion to the number of shares, whether preference or ordinary, held by them respectively."

"3. That so much of the special resolution of the company passed on March 12th, 1894, and confirmed on March 30th, 1894, as is inconsistent with the second of the above resolutions be, and the same is hereby rescinded."

The Chairman in proposing the resolutions said he did not think the first required any explanation, as it must be quite clear to everyone that notwithstanding the amounts already written off the patents stood at a higher figure than they could justly say was their true value. He would like to draw attention to the special resolution of March, 1894, creating the preference shares, and more especially to the latter part in which it was stated that in the event of writing off of capital the ordinary shares should be written down before the preference shares. It was a little difficult for the directors to decide how to inflict the least hardship upon the ordinary shareholders as it was their desire that although the face value of the ordinary shares was to be reduced by one-half, the dividends to accrue after the period during which the preference shareholders take nine-tenths of the net profits, should remain the same. According to the resolution of March, 1894, the ordinary shares would only be entitled to 10 per cent. on the amounts paid up, which in the event of the reduction now proposed being made, would be only £1, and any surplus profit would be divided according to the amounts paid up. That was to say, the ordinary shares would receive exactly one-half of the profit to which they were entitled at the present moment, which would mean a great increase in the amount to be received by the preference shares. The directors were therefore of opinion it was a fair consideration to the preference holders for giving up their right to this increase that the period during which they take nine-tenths of the profits should be extended for a further period of two years. They must not forget that it was due to the preference holders that they were in the satisfactory position they held to-day, as they came forward at a time when the ordinary shares were unsaleable at any price. They invested their money in a security which, if the company failed, would probably have been of little value, and the result was that the directors were enabled to extricate the company from the serious position it was in.

After considerable discussion the resolutions were carried by 14 votes to 3; and they were subsequently passed at separate meetings of the preference and ordinary shareholders.

United River Plate Telephone Company, Limited.

Mr. J. Irving Courtenay presided at an ordinary meeting of this company held at Winchester House on Tuesday last.

In moving the adoption of the directors' report and statement of accounts, he said: Two years ago after a considerable interval during which no distribution was made to the shareholders, they paid 3 per cent. last year they paid 4 per cent., and this year they had again the satisfaction of recommending an increase as they proposed a dividend of 5 per cent. Whatever may be the fluctuations in other business in the Argentine Republic, they had to record a steady and all round improvement in the telephone business. The gross receipts were £60,325 6s. 5d., as against £48,744 10s. the year before, and after deducting the working expenses—£30,204 14s. 2d.—debenture interest and other items as stated in the report, there was a net balance of £20,552, which with the amount brought forward from last year—£4,524 5s. 11d.—made an available balance of £25,076 5s. 11d. After payment of a dividend of 5 per cent., the substantial balance of £7,576 5s. 11d. was carried forward. Salaries and wages were somewhat higher. This was owing to the increase in the rates they had to pay the employés and the larger staff of operators necessitated by the increase of subscribers, and the fall in the gold premium, which results in a higher sterling value of the salaries and wages paid in currency. The reduction in the gold premium to an average of 192, as against 235 of last year, although increasing the sterling value of wages paid, has also substantially increased the sterling value of the receipts and of their profits. Storms have been frequent, and much damage had been done to properties by falling posts on roofs and parapets. Repairs and compensation for these damages have been charged to general expenses, and have made that account also higher. The increase in the number of subscribers was 480—a very satisfactory feature. On account of the claim against the municipality of Buenos Aires for the return of taxes, they had received since the closing of the books for the period under review $110,000 in 6 per cent. municipal bonds. There had been some exceptionally heavy work in connection with the Buenos Aires plant. A number of important changes and improvements have been made, involving much trouble and anxiety, but the results of the work have given great satisfaction. During the year negotiations were pending for the acquisition of a permanent central office site, a most important matter which has been constantly before the board for many years. These negotiations resulted early in April of this year in the purchase from the Mortgage Company of the River Plate of a valuable and centrally located site, with frontages upon the Avenida de Mayo and Rivadavia, which had been strongly recommended by the general manager in the River Plate, Mr. Chappell, and their consulting directors, Messrs. Fels and Krabbé. It was expected that work would be commenced on it in September or October. Taking a general survey of the position of the company, on the whole the past year had been marked by an evident improvement throughout, and as to the current year, though certain portions of the Argentine Republic may suffer from a variety of causes, there seems no reason why the business of this company should not continue to improve.

Mr. Bonner pointed out an increase from year to year in the London office expenses, and Mr. Lee Smith urged the advisability of paying interim dividends.

The Chairman pointed out that the increase in the London expenses was due to the directors receiving more than they had previously, although they were not receiving the full sum permitted by the articles of association. The board would entertain the idea of the interim dividend.

The report was then adopted, and after the re-election of directors and auditors, a vote of thanks was accorded to the staff.

Thomas Parker, Limited.

The annual meeting of the shareholders in Thomas Parker, Limited, was held at the works, Wolverhampton, on Tuesday afternoon, Mr. C. T. Mander, J.P. (chairman of the directors), presiding. The report of the directors appeared in our issue of last week.

The Chairman, in moving the adoption of the report, said they were a trading concern, and they did not want much to go forth to the public, except that they were in a prosperous condition. A large sum per annum was being turned over, and it had been found necessary to increase the shops and tools by 50 per cent. They could have accomplished more work but for the shops being unfinished, and the tools not being in positions as they ought to have been some four or five months ago, due to the congestion of trade. Nevertheless, gradually they were being put in place. They could have paid more than a 7 per cent dividend, but as they paid only 5 per cent. last year, he thought 7 per cent. was a fair increase, and it was just as well they should increase the dividends gradually, rather than pay large dividends one year, and have, perhaps, a nasty jar the following year, and be obliged to pay a smaller one. There would be carried forward to next year £1,167 odd. In addition to that they had "knocked off" somewhere about £3,000 in one way or another—patterns, machinary, plant, and other things. The directors considered that an ample sum, and felt fully justified in paying the dividend.

Mr. Thomas Parker, who seconded the resolution, said they had as many orders in hand as the whole turnover of last year, and they would soon be equipped in order to turn them out in half that time.

The Chairman added that they had now written off the whole of their preliminary expenses.

The motion was carried and the dividend declared.

Mr. C. T. Mander was re-elected director, and the auditors (Messrs. Allen, Edwards & Smith) were also re-elected.

The Chairman intimated that the board had decided to call up the remaining portion of the shares. When they first started he thought they would do well to leave a certain amount of uncalled capital in hand, which would make their credit better. Since then he had been advised differently, and their credit might be judged by the shares in the market. People did not care to pay above par if there was uncalled capital. Possibly in the course of another year they would have to re-arrange their capital, so as to deal with the orders coming in.

A vote of thanks to the chairman concluded the proceedings.

The Electric and General Investment Company, Limited.

Mr. George Herring presided at a meeting of this company, held at Winchester House on Friday last. He said the capital of the company remained as it was. The reserve fund had been ear-marked in the following manner: Securities had been taken from the company in the names of the trustees, and would be held for the benefit of the ordinary shareholders only; thus the trustees would receive the dividends, and would occasionally sell and divide to the ordinary shareholders only. Sundry creditors consisted of money lent to them, and from unclaimed dividends; the investments were well worth the money put down for them. Sundry debtors appeared a rather large sum; but, as a matter of fact, £17,000 was a mere matter of book-keeping, and the remainder were all good with the exception of a very small amount indeed. Turning to the profit and loss account, he did not think any shareholder could grumble at that; to make a gross profit of £15,000 on a paid up capital of £20,000 was very good. Referring to the contingency fund, they thought they were justified in having such a fund, so that next year's dividends would not be absolutely nothing; he said that because though they would receive from various sources almost sufficient to pay the outgoings, unless they undertook new business there would be no dividends. The chairman then related the various operations of the company in bringing out the various electric lighting companies, and the value of the shares in those companies. Referring to the Pioneer British Electric Traction Company, he did not think they would have to wait long for it to arrive at maturity, and he thought it would progress faster than any other. Fifty million dollars were invested in such enterprise in America, and he thought it would prove to be just as brilliant a success in this country. After a few more remarks the chairman moved the adoption of the report, which was carried.

The India-Rubber and Gutta-Percha Works Company, Limited.

The Hon. Henry Marsham presided at the half-yearly meeting of the company held at Cannon Street yesterday.

The Chairman said it was customary to call them together to obtain sanction for the payment of an interim dividend, and he had pleasure in proposing a dividend of 2½ per cent. During the past six months, with the exception of the submarine cable department, they had been fully employed, certain branches having to work longer hours than they considered advisable. To minimise this they were considerably extending their works and increasing the number of their workpeople. There were now employed at Silvertown 2,700 hands and at Persan Beaumont 500, making altogether with their agencies about 3,400. The turnover during the past six months had been higher than during the similar period of 1896. At the same time the price of raw material was higher and competition was keener. The cable steamers, *Dacia* and *Buccaneer*, had been employed on hire by other companies, and the *Silvertown* had sailed recently to assist in laying the North Atlantic cable, but the *International* had not been engaged. It had been under the consideration of the company to ask the Colonial representatives to view their extensive works; but as these gentlemen were so fully occupied, they considered it inadvisable to do.

A Shareholder asked if the litigation with the Dunlop Company had been settled.

The Chairman replied that the case had not yet come on.

The resolution was then adopted.

The Electrical Power Storage Company, Limited.

Mr. J. Irving Courtenay presided at the meeting of this company, held yesterday, and said the free balance, including the amount brought forward from last year, amounted to £4,485 5s., out of which the directors recommended a similar dividend to that of last year, viz., 5 per cent, after payment of which they would carry forward £242 0s. 2d. The buildings, plant and tools generally, were never in so good condition as they were to-day, and they had spent on their maintenance, renewal and repair during the last year £2,048 15s. 2d., and in addition they had expended £526 11s. 9d. on new plant. The number of plates sold during the year showed a marked advance on the sales of any previous year, thus indicating to some extent the importance of the goodwill of the company's business. The new Faure-King accumulator was receiving the favourable consideration of a large number of buyers, and they had on hand, among numerous other orders, contracts for this class of manufactures for the electric supply stations of the Corporations of Belfast, Aberdeen, and Dundee, and had already secured important orders for these batteries for motor car propulsion. This latter business, of which a good deal has been expected during the last two or three years, does not at present show much actual progress, but they would be interested to learn that the electrically propelled dog cart built by the Electric Construction Company, exhibited at the Crystal Palace, and which received the special commendation of the judges in the *Engineer* competition, was equipped with a Faure-King battery capable of running the vehicle 25 miles, a figure which represents working at twice the discharge rates given in their price list. This was a very hopeful departure, because the battery could be kept charged and properly maintained as new for a much less sum than it costs to fodder and attend to a horse. Referring to the general demand for the new Faure-King accumulator, if they had not taken the new premises as mentioned in the report, they could not have executed the orders with such promptitude as was now possible. In regard to the recent debenture issue, all the debentures were quickly subscribed. As is evident from the fact that there were 10 to 12 firms advertising as manufacturers of accumulators, competition was of the severest character, and the margin of profit is now so low, that he doubted whether some of the competitors could succeed in making both ends meet at the prices which they are quoting. There was one point which he thought had not been sufficiently ventilated, and that was the demand for personal sureties for duly carrying out the contracts made by corporations and companies wherever there were large contracts to be dealt with. The company had always given really effective guarantees for the carrying out of these contracts, but he did not see how the class of guarantee, say, for five or ten years, he heard of as being given, could possibly be considered as an effective guarantee. This was a most important point, and worthy of serious consideration by the consulting and acting engineers whose business it was to safeguard the interests of their respective companies or corporations over a term of years.

After a few remarks, during which the chairman said the maintenance was paid out of revenue, the report was adopted, and a dividend of 5 per cent. declared.

Smithfield Market Electric Supply Company, Limited.—Last Saturday's issue of a financial contemporary contained a notice to the effect that the above company will shortly make an issue of its capital of £100,000, in shares of £5 each, and of debentures amounting to £50,000. It is claimed for this company that it will hold the unique position of commencing its career as a dividend-paying concern, no other electric company having commenced business with a revenue.

The Yorkshire House-to-House Electricity Company, Limited.—The directors have resolved to pay an interim dividend upon the ordinary shares at the rate of 5 per cent. per annum for the half-year ending the 30th ult., this being the same rate as paid for the corresponding period of 1896. The dividend will be payable on the 21st inst., and the transfer books of the company will be closed from the 14th to the 20th inst. inclusive.

Electric Construction Company, Limited. — The directors have resolved to recommend a dividend on the ordinary shares for the 11 months ending May 31st, at the rate of 6 per cent. per annum, one-half payable on 31st inst. and the other on February 1st, 1898. The transfer books for the ordinary and preference shares will be closed from July 8th to 22nd inclusive.

Stock Exchange Notices.—Applications have been made to the Stock Exchange Committee to appoint a special settling-day in, and to grant a quotation to: City of London Electric Lighting Company, Limited, further issue of 10,000 ordinary shares, Nos. 80,001 to 90,000. National Telephone Company, Limited, further issue of 130,766 5 per cent. non-cumulative preference shares.

Eastern Extension, Australasia, and China Telegraph Company, Limited.—The interest on the 4 per cent. mortgage debenture stock for the half-year ended 31st inst. will be paid by warrant on August 3rd next. The stock register will be closed from the 28th to the 31st inst., both days inclusive.

British Insulated Wire Company, Limited.—We understand that the list of applications for the preference and ordinary shares closed last week, and it was found that the issue had been subscribed three times over. The first batch of letters of allotment and regret were sent out early in the week.

Edison and Swan United Electric Light Company, Limited.—We understand that the £90,000 4 per cent. debenture stock just offered to the public has been fully subscribed.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending July 4th, 1897, were £1,031; week ending July 5th, 1896, £881; increase, £150; total receipts for half-year, 1897, £1,031; corresponding period, 1896, £881; increase, £150.

The Cuba Submarine Telegraph Company. The traffic receipts for the month of March were £4,197, as compared with £6,517 in the corresponding month of last year.

The Liverpool Overhead Railway Company. The receipts for the week ending July 4th, 1897, amounted to £1,416; corresponding week last year, £1,286; increase, £130.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending July 2nd, 1897, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,013.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years.			Closing Quotation, June 30th.	Closing Quotation, July 7th.	Business done during week ended July 7th, 1897.	
			1894.	1895.	1896.			Highest.	Lowest
149,900£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	...	100 —104	99 —103 xd	...	...
25,000	Amason Telegraph, Limited, shares...	10	...	...	...	5 — 6	5 — 6	...	...
923,960£	Anglo-American Teleg., Ltd.	Stock	£2 2s.	£2 9s.	£2 13s.	54 — 57	54 — 57	56⅛	55
3,038,020£	Do. do. 6 % Pref.	Stock	£4 4s.	£4 18s.	£5 6s.	100 — 101	100 — 101	101¼	100¼
3,038,920£	Do. do. Defd.	Stock	...	...	...	10½ — 11	10½ — 10⅝	10 15/16	10½
130,000	Brazilian Submarine Teleg., Ltd.	10	7 %	7 %	...	14¾ — 15½xd	14¾ — 15½	15 3/16	15
75,000£	Do. do. 5 %, Debs., 2nd series, 1905	100	5 %	5 %	...	113 - 117 xd	113 —117	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	2½%	4 %	..	3½ — 3⅝	3½ — 3⅝	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	170 — 175 xd	170 —175	...	...
653,586£	Do. Do. Sterling 500 year 4% Deb. Stock Red.	Stock	...	...	....	106 —107 xd	106½—107½	107⅜	106½
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	1½%	1½%	2 %	1/16 — 1/16	1/16 — 1/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	9 — 10	9 — 10	9⅛	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20	19 — 20	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	3½ — 4⅛	3½ — 4⅛	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	9½ — 10⅝	9½ — 10⅝	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	4½%	4½%	4½%	103 —106¾xd	103 —106 %	...	...
60,710	Direct United States Cable, Ltd.	20	2 %	2½%	2½%	9 — 9½	9½ — 10	9⅝	...
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½%	6½%	...	17 — 17½	17 — 17½	17⅜	17½
70,000	Do. 6 % Cum. Pref.	10	6 %	6	...	18 — 19	18 — 19	18¼	...
89,900£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	...	103 —106	103 —106	...	...
1,302,615£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	128 —131	128 —131	...	...
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7⅛	17⅝— 18¼	17⅝— 18¼	18	...
35,500£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	5%	101 —105	99 103 xd	...	...
133,100£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	5%	102 —105	100 —103 xd	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4%	129 —132	129 —132	...	...
51,100£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5%	101 — 105	99 —103 xd	...	...
69,200£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5%	102 —105	100 —103 xd	100½	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4%	105 —108	105 —108	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4%	107 —110%	107 —110 %	109	...
180,227	Globe Telegraph and Trust, Ltd.	10	4½%	4½%	4½%	11¼ — 11⅝	11¼— 11⅝	11⅝	11½
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6%	17 — 17½	17 — 17½	17 1/16	17
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅜%	10 %	10⅜	25 — 26	25 — 26	25⅞	25½
160,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5⅛	104 —107	104 —107	104½	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10%	54 — 57	54 — 57	56	54
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	6%	107 —110	107 —110	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	4 %	4 %	...	2 — 2¼	2 — 2¼	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 %	5⅛%	5⅛%	6⅝ — 6⅞	6⅝— 6⅞	6 13/16	6⅞
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6 — 6¼	6 — 6¼	6⅜	6¼
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	103 —107 xd	103 —107	106½	105
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	4½%	5 %	5 %	⅝ — ¾	⅝ — ¾	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	106 — 109 xd	106 - 109 xd	...	...
11,839	Reuter's Ltd.	8	nil	5 %	5 %	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	135 —140	135 —140	...	...
58,000	United River Plate Teleph., Ltd.	5	3 %	4 %	...	3⅜ - 4¼	3⅜ — 4¼	4⅛	4
146,733£	Do. do. 5 % Debs.	Stock	5 %	5 %	...	98 —103 xd	99 —104	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	nil	4 %	nil	5 — 6	5 — 6	...	...
213,400£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	101 - 104	101 —104	...	...
64,256	Western and Brazilian Teleg., Ltd.	15	3 %	3 %	2 %	8 — 8½	8¼ - 8⅜	8 5/16	...
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	5 %	6½ — 7	6½ — 7	...	...
33,129	Do. do. do. Def. Ord ...	7½	1 %	1 %	...	1⅝ — 2¼	2 — 2½	...	...
382,230	Do. do. do. 4 % Deb. Stock Red. ...	Stock	...	...	...	98 —101 xd	99 —102	101	100½
88,321	West India and Panama Teleg., Ltd.	10	¼%	¼%	1 %	⅞ — 1⅛	⅞ — 1⅛	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	10½ — 11	10½ — 11	10⅝	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	9 — 10	9 — 10	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	5 %	105 —108 xd	105 —108	...	...
1,163,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	7%	104 —108	104 —108	...	...
160,100£	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	6%	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	5 %	6 %	13 — 14	13 — 14	13¼	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6¼ - 6⅜	6¼— 6⅜	...	...
26,000	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	5 %	9⅜— 10¼xd	9⅜ — 10¼	9⅜	...
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	4½%	4½%	110 —113 xd	110 —113	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	5 %	5 %	7 %	23½ — 24½	23½ - 24½	24	23⅞
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	17 — 18	17 — 18	17⅜	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	129 —131 xd	129 —134	130½	129½
22,475	County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1—22,475	10	..	nil	nil	12⅝— 13¼	12⅝— 13¼	13⅛	13
10,000	Do. do. do. 6% Pref., 40,001—50,000 ...	10	...	6 %	6 %	15 — 15½	15 — 15½	...	...
10,000	Do. do. do. iss. at 2 pm., all paid	10	...	...	..	14¾ -- 15½	14⅝— 15½	15 1/16	...
10,000	House-to-House Elec. Light Supply, Ord., 101 to 10,100	5	...	...	...	8½ — 9	8½— 9	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	3 %	4 %	5 %	16½ — 17⅛	16½— 17½	17⅛	16⅞
12,500	Do. Ord., 50,001—62,500, iss. at £2 prem. ...	10	...	...	...	16 — 17	16 — 17	16 15/16	16½
220,000	Do. 4½% first mortgage debenture stock	...	4½%	4½%	4½%	118 —122 xd	118 —122	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	1 %	2 %	4 %	15 — 16	15 — 16	15 1/16	15
19,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	6½%	7½%	10½%	15½ — 16½	15½— 16½	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	10 — 11	10 — 11	...	...
50,000	Do. do. 4 % Deb. stock Red. ...	Stock	...	...	...	102 —105 xd	102 —105	...	...
67,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	5 %	7 %	9 %	15 — 16	15½— 16½	15⅝	15½

* Subject to Founder's Shares.
‡ Unless otherwise stated all shares are fully paid.
§ Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share ‡	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation, June 30th.	Closing Quotation July 7th.	Business done during week ended July 7th, 1897. Highest.	Lowest
20,000	British Electric Traction	10	...	...	...	12 — 12½	12 — 12½	12	...
90,000	Brush Elecl. Engng. Co., Ord., 1 to 90,000...	8	2½%	...	...	1⅛— 1⅜	1⅛— 1⅜	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	...	...	1½— 1⅝	1½— 1⅝	1⅝	...
125,000£	Do. do. 4½ % Perp. Deb. Stock.... ...	Stock	4½%	...	...	105 —109	105 —109	...	...
76,770	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock	...	...	...	93 — 97 xd	93 — 97	93	...
13,126	Central London Railway, Ord. Shares	10	...	...	...	9⅜— 10⅛xd	9⅜— 10⅛	...	...
143,106	Do. do. do. £6 paid ...	10	...	...	...	5⅞— 6⅛xd	5⅞— 6⅛	...	...
58,830	Do. do. Pref. half-shares £1 pd. ...	...	...	...	...	1¼— 1⅜xd	1¼— 1⅜	1¼	1⅜
61,777	Do. do. Def. do. £5 pd. ...	...	...	...	...	4¼— 4⅜xd	4¼— 4⅜	4⅜	...
630,000£	City and South London Railway	Stock	1½%	1 5/16%	1 9/16%	59 — 61	59 — 61	61	60½
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	*nil*	*nil*	...	1⅜— 2¼	1⅜— 2¼	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	5 %	5 %	...	2¼— 2⅜	2¼— 2⅜	2⅜	...
17,139	Do. do. do. "A" Shares 01—017,139	5	5 %	5 %	...	3½— 4½	3½— 4½	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	5 %	...	1⅜— 2	1⅜— 2⅜	2 1/16	1 15/16
16,343	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	...	2⅜— 3¼	2⅜— 3¼	3	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	...	...	¾— 1	¾— 1	...	...
67,275	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	...	...	½— ⅝	½— ⅝	...	...
9,600£	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	*nil*	10½%	...	9 — 11	9 — 11	...	...
12,500	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	6 %	8 %	10 %	19 — 20	18½— 19½	19	...
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	18½— 19½	18½— 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	4½%	4½%	108 —113	108 —113	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	10 %	10 %	10 %	20½— 21½	20½— 21½	...	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	105 —108	105 —108	107½	105½
27,500	†Liverpool Overhead Railway, Ord.	10	1½%	2⅞%	2⅞%	12½— 12⅝	12½— 12⅝	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	15½— 16	15½— 16	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	15 %	15 %	37 — 40	37 — 40	38¼	37¾
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	104 —107	102 —105 xd	...	...
54,000£	Waterloo and City Railway, Nos. 1 to 54,000, £8 paid ...	10	...	...	...	10⅜— 11¼xd	10⅜— 11¼	...	...

Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7½%; 1890—8%

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (£4 paid), 7⅞, £5 (fully paid) 9¼.

Electric Construction Corporation, 6 % Debentures, 102—105xd.

House-to-House Company, 7 % Preference, of £5, 10¼—10⅜.

Do. do. 4½% Debentures of £100, 108—110.

* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 13—13½; 1st Preference Cumulative 6 %, £5 (fully paid), 8¼—8⅜. Dividend, 1896, on Ordinary Shares 7 %.

London Electric Supply Corporation, £5 Ordinary, 1⅜—2.

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 8¼—8⅜. Dividend for 1896—6 %.

Bank rate of discount, 2 per cent. (May 13th, 1897).

THE MUNICIPAL ELECTRICAL ASSOCIATION, 1897.

(*Continued from page* 31.)

MUNICIPAL AIDS TO WIRING.*

By Alfred H. Gibbings, Borough Electrical Engineer, Bradford.

The subject of this paper is at the present time engaging the attention of many municipal electrical engineers, and the reason is obvious. The object in view, of course, is to encourage by all possible means the use of electric current, or in other words, to secure additional consumers. Extended business would add to the profits of the business if already paying its way, and would enable many a small though enterprising town to turn an unprofitable into a profitable concern.

Several inducements for increasing the demand for electricity, and for popularising its many applications, are already in the field. Among the more noticeable of such enterprises may be mentioned the following:—

1. Laying the service free of cost.
2. Abolition of meter rents.
3. Reduced prices for motive power.
4. Penny-in-the-slot meters.
5. Maximum demand indicators.
6. Free supply of incandescent lamps.
7. Hiring out of fittings, motors, heating apparatus, arc lamps, &c.
8. Free wiring.

Upon most of the above the author has already made several communications to the electrical technical press of this country, and a general review of the question was given by him under a pseudonym in *Electricity* for January 1st, 1897.

In that article the subject of free wiring was considered from its two most important aspects, viz :—(1) The position of the private householder, and (2) The direct or immediate effect on the supply undertaking and the cost per unit. These two points, however, we may say, have undoubtedly already received a fair amount of attention and consideration from a broad general point of view, and the same may be said of the other items enumerated above. There is another point of view which it is the author's intention to bring before you, and which in his opinion is after all of more real moment to all municipal electrical undertakings in this country. It is the question of obtaining extended powers and resources to take up, develop, and work these enterprising methods. At the present time, however remunerative such methods as free wiring and hiring out of motors, &c., may be seen or proved to be, and however much a municipal corporation might desire to adopt them it is not able to get the necessary permission to borrow the capital for the purpose. Municipal corporations are therefore placed at a great disadvantage in this respect compared with public and private companies, and even with municipally owned gas undertakings which are not so circumscribed with restrictions.

Of the eight items enumerated as inducements to a more extended use of electricity on the part of the public, the last two alone are those upon which municipal corporations have no power to borrow money. The consequence is that it has been considered worth while to form a public company for the exploitation of this particular business, and there can be no question but that the scope of their operations will be very wide. Through the medium of an independent company, therefore, electric supply undertakings will still be able to offer free wiring and the hiring system to the public. The author, however, is of opinion that it would be most desirable for many reasons that municipal corporations should have the control of all such matters entirely in their own hands. Some of these reasons may be found in the many advantages which municipally owned undertakings bring to the citizen through the operation of each department in one interest. They include the facilities for borrowing the necessary capital at low rates of interest; the collection of accounts by one department; purchase and guaranteed supply of articles of good quality and value; competent workmanship; and others which are equally familiar and apparent to you. All these things must operate in the direction of a true economy in initial expense of wiring and fittings, and hence the actual charges made to the public must be much less than would be the case where these collateral enterprises are in the hands of private trading concerns. There is no need, however, to dilate further upon the advisability of having such matters as free wiring and the hiring out of motors, arc lamps, &c., under the control of the corporations owing electric works. There is, I am aware, considerable objection taken by some corporations against too extended municipalisation, on the ground that it interferes with private trade, but the power or option of doing certain work, or of carrying on certain schemes should not necessarily imply a monopoly. Private enterprise need not be interfered with, but there is no valid reason why the corporation should not be its competitor. If, as would probably be the case, the corporations took up the schemes referred to in a proper commercial spirit, then the consumer would be the gainer, and the profits accruing, instead of feeding the pockets of private capitalists, would be applied to the reduction of the borough rates.

* Read at Manchester, June 30th, 1897.

Having thus briefly introduced the subject, the author would suggest that the association should take such steps as are necessary towards ascertaining the opinions of the various corporations upon the question, with the ultimate view of approaching the Local Government Board for powers to borrow money for these purposes.

STREET LIGHTING BY MEANS OF RECTIFIERS.*

By C. D. Taite, A.I.E.E., Borough Electrical Engineer, Southport.

Series arc lighting by means of rectifiers is now becoming so general, that a few facts relating to their use may be of interest, and as the writer has had special opportunities of studying their behaviour at Southport, he trusts that this will be a sufficient excuse for so frequently quoting the results obtained there in preference to those obtained in other towns.

The constituent parts of a rectifying set, as used for series arc lighting, are a synchronous motor, a commutator having the same number of sections as the motor has poles, and mounted on the same shaft, and a constant current transformer. The latter is perhaps the most interesting part of the whole apparatus, its construction is so simple, and its automatic regulation so perfect.

Since the introduction of rectifiers, about three years ago, into practical work at Portsmouth, their use has spread very rapidly, so that at the present time they are being employed at no fewer than 10 electricity supply stations, and they have been specified for at least three more stations now in course of construction.

Under these circumstances it will not be out of place to inquire into the causes which have led station engineers to adopt rectifiers in place of the old Brush and Thomson-Houston arc lighters.

These causes appear to the writer to be:—

(*a*) Efficiency. (*b*) Small up-keep. (*c*) Minimum of floor space.

The one which undoubtedly appeals most strongly to the engineer is efficiency.

It is very difficult to obtain exact details as to the saving in steam consumption through the use of rectifiers, but it is evident that where one engine can be run to do both the incandescent and the arc lighting there must be a considerable economy in coal. This is evidenced by the coal returns of Portsmouth (67d.), and Southport (·47d).

The electrical efficiency of a rectifier where a number of lamps are run in series is high; at Southport, 43 15-ampere arcs are worked in series; the input given to the rectifier (including both the motor and the constant current transformer) averages 33 units per hour; the output is 15 amperes at 2,050 volts, or 30¾ units, giving an efficiency of rather over 93 per cent.; that is, at full load. At half-load the efficiency is still good; the units per hour required with 22 lamps burning are 17·5, and the output is 15 amperes at 1,020 volts, giving an efficiency of 87·4 per cent. The above tests extended over several months, the power taken by the rectifier being measured by Thomson-Houston wattmeters, and the output by a Kelvin voltmeter and two Nalder ammeters.

It will be noticed that the average power per lamp at full load is 767 watts, and at half load nearly 800 watts; in order therefore to test the accuracy of the results obtained from the wattmeters, the engine was indicated with—

(1) 43 lamps burning,
(2) 22 lamps burning;

the average results of three sets of diagrams taken in each case showed a difference of 20·4 horse-power, that is to say, when 21 lamps were cut out, the power required from the engine was reduced by 20·4 horse-power, thus confirming very closely the results obtained from the wattmeters.

This high efficiency at small loads is a very important matter when it is not intended to run the rectifier always fully loaded. The power factor was not so satisfactory, being 87·3 per cent. at full load, and only 45 per cent. at half load.

With a few lamps in series, as, for instance, at Cardiff, where only 12 lamps were run off each transformer when the rectifiers were first installed, but with the motor running two commutators, the efficiency is much lower, being not more than 80 per cent. at full load; this is accounted for by the relatively greater amount of power required by the motor in this case, and by the loss of power due to using two transformers in place of one.

Where the cost of land is at all great, a considerable saving may be effected by using rectifiers; two rectifiers, complete, require about 5 feet by 13 feet, and this space includes 17 inches at the back and in front of each set, as well as 2 feet between them, and a foot on each side. The first cost is not very heavy, and the up-keep is low, thus at Southport the total repairs and maintenance, including brushes, amounted to £19 15s. during the last year, of this amount rectifier brushes cost £6 15s., and renewals to commutators £10, leaving £3 for the cost of oil, grinding gear, &c.; the gross income from the lamps was £840; thus the repairs, &c., to the rectifiers work out at 2·35 per cent., or since 94,400 units were rectified, the repairs per unit amounted to ·05d. In stations where so much power is not dealt with on the commutator, these costs could be still further reduced.

With only one or two rectifiers running at once, the writer has not found it necessary to employ any extra labour, or, in fact, any specially skilled labour, to keep the apparatus in order. The attendants very soon pick up the special points which it is necessary to keep in view in order to obtain satisfactory running. Amongst the most important of these is to keep the brushes well trimmed and accurately set, and to be careful to see that the commutator is clean: the voltage is another point which requires close attention; the highest pressure, consistent with steady running, is the best, as the higher the pressure the better the motor stays in synchronism, but a large variation from a certain definite mean (which may be slightly different for each motor) is not permissible, as hunting is sure to be the result. Every motor the writer has yet come across will stand 10 per cent. variation in pressure either up or down, but beyond that it is not safe to go; it is well, therefore, to find out at the commencement the best pressure for the motor, and as far as possible to always run it at that particular pressure.

There is one other point essential to really satisfactory running, *i.e.*, an even turning moment on the crank shaft of the engines; any irregularity is instantly reflected by a beat in the motor and a consequent lengthening and shortening of the spark on the commutator, but given a good drive, well trimmed motor brushes and ordinary care, there is little fear of the motor giving any trouble.

PUBLIC STREET LIGHTING.*

By H. L. P. Boot, Borough Electrical Engineer, Tunbridge Wells.

This subject forms one of the most difficult questions that confront the electrical engineer in connection with the supply of electric energy, especially in towns where consic erable opposition is experienced from local interests. People expect great things when making alterations to their public lighting, and experience shows that they are not satisfied by being given the same amount of light in another form, although it may put money into their own pockets, instead of into a rival company's. It is exceedingly difficult to convince councillors and the public generally, that by lighting their streets in a manner which is worthy of the 19th century, they are decreasing crime, assisting in maintaining law and order, and educating the people one step further in civilisation. Referring to the early days of the illumination of public streets, it was considered, and that not very long ago, that it was unnecessary to light them at all, except a few of the principal ones, and these only with the poor light afforded by an oil lantern; hence, if we trace the steps of civilisation, we find that every year there is a general advance in obtaining better lighted streets. There is, however, the cry of the so-called "economist," whose main object seems to be to keep down the rates at the expense of the efficiency. No better or greater benefit that can be conferred on the public generally, than by giving them perfectly lighted, watered, cleaned and paved streets in the borough. The main object in carrying out these duties should be to execute them in the best possible manner and at the least possible expense, but not because of the expense neglect them, or do them in an inefficient manner. The object of the author in submitting this paper is to afford an opportunity for discussion for towns that have started their electricity works, but have not finally made up their minds as to the value of electricity as a street illuminant—the paper only applies to towns in which both private and public lighting are undertaken by municipal authorities, and with works supplying energy on the high tension system. The first point that should be considered, or perhaps which is considered, is that of expense, and it has been the author's practice to endeavour to light the public streets with electricity in preference to gas at the *same* cost. This could be undertaken provided the authorities and the public were satisfied with the same amount of light; unfortunately this is not the case, and we find them clamouring for more light, and clamouring because the light costs more. No doubt most works that have been started some time have gone through this stage, and are appreciating the value of good public lighting. An intelligent ratepayer would have no objection to the rates being slightly higher, provided he gets good value for his money, which can undoubtedly be supplied. To undertakings about to start, it is often proposed that public street lighting should be postponed until such time as the profits on the private consumers are sufficient to pay the additional cost for better lighting. Surely this is a most unfair and unjustifiable manner of proceeding. When should arrangements be made for street lighting? Undoubtedly the answer to this is—at the same time as the private lighting cables are being laid, and the time is not far distant when we shall find that wherever there is an electricity cable laid for the supply of energy, the streets will be lighted by the same agent, therefore the answer is, that it should be undertaken when the works are *first* laid down, and then not in a half-hearted sort of a manner (as is too frequently the case), because at a future date the cost of remedying this want of courage and foresight is heavy, and handicaps the extension of public lighting. Under our present system of loans, let us briefly consider the various methods by which electricity can be used for public lighting:—

(1*a*) By Arc Lamps.—This leads us to ask the question when and where should an arc lamp be used, as there is no doubt arc lamps are used in places where they certainly should *not* be, also *vice versâ*, glow lamps are used where arc lamps should be. It is an accepted theory that, wherever the largest amount of traffic and the greatest number of people congregate, such as principal streets, squares and open places, the most light should be given. The position in which an arc lamp is placed very often determines whether it is a success or a failure; the best position, if the street or road be wide enough, is certainly in the middle, where a better diffusion of light all round is obtained. The distance apart at which arc lamps are placed must of course vary according to circumstances, but the author is of the opinion it should never exceed 100 yards. Below is a table showing the distance in yards of the arc lamps in several towns:—

Chelmsford	80 yards.
Cardiff	55/70 yards.
Newport	70 yards.
Blackpool	50 yards.
Portsmouth	90/100 yards.
Derby	45/90 yards.
Kingston-on-Thames ...	110 yards.
Londonderry	75/300 yards.
Brighton	70 yards.
Hanley	60/70 yards.
Bedford	40/60 yards (glow lamps).

* Read July 1st, 1897.

From the table it will be seen that few towns seem to be of the same opinion as to the correct distance. This is in many instances influenced by the following points (*a*) Economy, or the desire to displace as many gas lamps as possible with one arc, (*b*) the position of side streets off the main. It is also a disputed question as to what is the most efficient candle-power for an arc lamp to give, for we find that the watts consumed (granting that the lamps are of a fairly equal efficiency) in various towns is different: the author's experience has been that the best effect for the money can be obtained by using rectified arc lamps of 500 watts, or alternating arc lamps taking 570 watts.

(2) We will consider the question of arc lighting under the following heads:—

(A) By separate plant. That is, putting down a separate engine, and direct current high tension dynamo, running the arcs in series. There are very grave objections to adopting this plan. *Firstly*, the capital outlay is heavy. *Secondly*, the efficiency of running the plant is poor, inasmuch as the street lighting load should undoubtedly be taken from the same bus-bars that supply the energy for private consumers. *Thirdly*, a separate plant requires a separate repairs item to itself, extra outlay per kilowatt, expense of steam and exhaust piping, separate consumption of oil, and separate standby in the event of failure. There is in the future every chance of this system becoming obsolete.

Referring to this list, one cannot help being surprised at the great difference given in the cost of supplying energy to public street lamps, and the only way it can be explained is that in every town the capital outlay per lamp varies according to local conditions, from which it is evident that the price at which energy can be supplied for public lighting is governed by (*firstly*), the cost of fuel to enable that supply to be given, and (*secondly*) the interest and sinking fund charges on the capital outlay expended on that lighting, (*thirdly*) the amount of public lighting undertaken. It is therefore important in considering which system to recommend any corporation to adopt, to consider the above points carefully, also what they are paying for their present public lighting. We will therefore consider the systems from these points of view, (*firstly*), taking lighting the streets by public arc lamps, the following is assumed:—That the loans are granted for 25 years, in other words are repayable in that time, (*secondly*), that the cables are laid separately, and not when the other feeders are laid, as, if the latter were the case, the cost of excavation and making good should be deducted or shared between the number of cables that are being laid at any one time, (*thirdly*), that all lamps require to be turned on in position; that is, not being controlled at the works, are turned on and off by the policeman, when passing that post on his usual beat, by a special key. Mention may be made here that this system of the police turning on and off the incandescent lamps when passing on their beat has now been in vogue

Name of town.	No. of arcs.	Incandes.	Distance apart in yards.		Capital outlay per lamp.		Cost to electricity works.		Number of hours burning.		Price charged per lamp.	
			Arcs.	Incandes.	Arcs.	Incandes.	Arcs.	Incandes.	Arcs.	Incandes.	Arcs.	Incandes.
Chelmsford ...	20	578	80	50	...	...	...	...	3,687	3,687	£22 10s.	£2/6/10
Cardiff	52	...	75/70	...	£34	...	£32	...	3,824	...	£18	...
Newport ...	42	...	70	...	£48	...	£18 10s.	...	2,787	...	£25	...
Blackpool ...	105	...	50	...	£47	...	...	...	2,000	...	4·8d. per	unit.
Portsmouth ...	264	482 (32 C.P.)	90/100	...	£40	...	1½d. per	unit.	1,800	2,165	£18	...
Halifax	11	22 (32 C.P.)	placed on	ly in open spa ces	£19	£2	...	...	till 11.30	11.30 to daylight	4½d. per	unit.
Derby	77	4 (50 C.P.)	45/90	...	...	...	2d. per hour arcs.	...	3,500	...	4½d. per	unit.
Kingston-on-Thames	36	2 (32 C P)	110	45	£69/3/4	...	£14 10s.	£3	3,400	...	£20	£3 10s.
Londonderry ...	174	...	75/300	...	£108	...	£12 6s.	...	3,000	...	£20/12/5	cost.
Brighton ...	252	580 (8 C.P.)	70	40	£55	£2 5s.	£27 7s.	£3 2s.	3,864	...	aver. price for both	3 44d. kinds
Hanley	60	30 (16 C.P. & 25 C.P.)	50/140 wi	h a small lamp mid way 60/75	£50	£6 w'out column.	£16 (8d.) larger at 2·5 p. unit.	£3	3,900	...	£16	£3
Bedford... ...	...	350 2 8 C.P. o 2 100 C.P. on one post.	40/60	...	...	£12	...	...	...	...	2½d. per standing of £1	unit plus charge 5s. 9d.

(B) By motor generator. The author is not aware of any station that is operating by this method, but it certainly has a slight advantage over a separate plant, inasmuch as the total energy going out from the station is supplied from one common bus bar, and therefore the plant can be worked more efficiently.

(C) By rectifiers. This is far and away the best method of lighting the public streets for the following reasons:—

(1) The arc lamps require no more energy than the direct current lamp.

(2) They give a higher candle power.

(3) The lamps require very little attention, probably on account of the fact that there is sufficient vibration to keep the lamp feeding, and prevent the mechanism sticking.

(4) The capital outlay is not so heavy as a separate plant or motor generator. The repairs item is exceedingly small where properly managed, in fact in the author's special case the rectifiers have not cost 1d. since the day they were put down.

(5) The constant current transformer supplied executes its work in a most efficient manner, and regulates the current perfectly; even when 75 per cent. of the lamps are turned out.

(6) They have the advantage of keeping the units working at their highest efficiency, as during the hours of darkness the public and private supply can be run off the same bus bars.

(7) Little attention is required, in fact, no more than if a high speed plant were running, the rectifying commutator only requiring oiling occasionally.

Disadvantages.—There is of course a certain liability of the motor running out of synchronism, thus causing the rectifying commutator to "flash over," this is especially noticeable when the load is coming on rapidly, also when the motor is new.

(D) Using the same plant entirely as supplies the private lighting. To alternate current engineers this seems the easiest solution of the problem, and now that manufacturers are placing upon the market alternating current lamps that are equal to direct current, it seems where extensions to the public lighting are required, provided the private supply cables are already laid, this system will be largely adopted.

Before considering the capital outlay involved on the various systems per lamp, the author submits a table giving particulars of several towns, and what they have done in the way of public lighting.

some 16 months with perfect success in Tunbridge Wells. The only precaution that has to be taken is that the switches and keys must be made extra strong, or else the "custodian of the law" will very soon break them, owing to the fact that he treats them as roughly as he would a criminal. It has not been found necessary to in any way alter the men's beats, the entire force having keys, so that the man passing the lamp at the nearest hour at which it should be lighted or extinguished, operates same. From the author's previous remarks, it is evident that he considers the rectified system of arc lighting superior to any other system introduced, and it will be interesting to take an actual example of the cost of public lighting by this system in the town which he represents. The capital outlay is worked out on the assumption that there are only 25 arc lamps to be supplied on one circuit:—

Capital Outlay.

Cost of rectifiers complete (including one spare) ...	£373	3	6
" 25 arc lamps (including four spare ones) ...	262	10	0
" 25 arc lamp columns (at 10 guineas each)...	263	10	0
" 25 H.T. switches for isolating purposes (at £2 9s. 6d.)	61	16	6
" 1 trimming ladder (at £13 10s.)	13	10	0
" arc lighting cable at 1s. 8d. per yard) ...	231	0	0
" laying, excavating, making good pavement, &c.	288	15	0
" 25 service boxes (at £1 each)	25	0	0
" 7 straight through boxes for jointing lengths of cable	4	5	0
" labour in connecting boxes, sundries, &c.	48	0	0
Total	£1,570	11	0

Cost of Supply.

Interest and sinking fund charges, amounting to 6 per cent. on capital outlay	£94	4	7
Labour in trimming, attendance, &c....	156	0	0
Cost of supplying energy, 25 by 920 units at 2d. per unit	191	0	0
Carbons	30	12	6
Total	£471	17	1

From which it will be seen that the labour item is heavy. This is accounted for by the fact that the area covered by the lamps from which these costs were taken is extremely large and scattered, and secondly, that the small number of lamps to be dealt with causes this item to appear much higher than if there were twice the number, inasmuch as the cost of labour would be the same; the same number of men would only be required to trim twice or three times as many. Dividing the above capital outlay by the number of lamps, we find that it costs £62 8 per rectified arc lamp; and the cost of supplying, including all capital charges, 4·92d. per unit, or £18 9 per annum.

Scanning the figures in the capital outlay, one naturally endeavours to find which item can be reduced, so as to reduce the actual cost per unit, and the only figure in which a substantial reduction can be made is that of laying the cable, or rather the cost of the trench work, amounting in this instance to £288 15s. This cost arises from the timidity of the public, as if the cables were laid at the same time and in the same trench as that prepared for the reception of the feeders, this outlay would be entirely saved. This forces us to the conclusion that the most economical policy to adopt is, wherever cables are being laid or extended, to make arrangements for the lighting of the public lamps along that route, either by means of the same distributor that supplies private consumers, or where the houses are isolated and some distance from the road, to run a small distributor along with the feeder, placing a small pit transformer capable of supplying the required number of lamps, both up and down the road in which the feeder has been laid, that transformer being fed off the aforesaid feeder; that is the only method by which the public street lighting in outlying districts can be undertaken at anything like the same price as that charged for gas.

It is unnecessary to go fully into comparisons or the cost entailed by adopting the various methods of arc lighting, means of supply and method of control mentioned in this paper, but it will suffice for our purpose to consider one other system which competes very favourably —that mentioned in paragraph 2, item "D." We will now proceed to treat this in the same manner as we did the cost of rectified arcs, but with the following assumptions:—(1) That the lamps are turned on and off by the policemen at required times; (2) That the arc lamps are only required in districts where high tension feeders are already laid.

Capital Outlay.

Cost of 25 service boxes	£25	0 0
„ 25 arc lamps (including four spare ones) ...	262	10 0
„ 25 lamp posts	262	10 0
„ 25 transformers	200	0 0
„ 25 switches	61	17 0
„ 1 ladder...	13	10 0
„ service cable at £1 per post	25	0 0
„ labour in fitting boxes	48	0 0
	£898	7 0

Cost of Supply.

Interest and sinking fund charges at 6 per cent. on capital outlay, amounting to	£54	0 0
Labour attendance, trimming, cleaning, repairing ..	156	0 0
Generating lamps alight up to 12 o'clock (570 watts)	217	10 0
Carbons	30	0 0
	£457	10 0

The figures above show that the capital outlay by using the alternating current arc lamp amounts to £35 per lamp, as against £62·9 for rectified. The cost of supplying energy to same, including interest and sinking fund charges, works out at £18·2 per lamp, as against £18·9 for rectified ones. Each arc lamp erected on the alternating current system costs about 15s. per annum less to the electricity works than if it were run on the rectified current system. In Tunbridge Wells we have both systems in use, and undoubtedly we would have extended the rectified arc lamps, but for the fact that it is an extremely scattered town, and it would be necessary to run a very long cable from the works before any lamps were taken off it at all, and for that reason alternating current arc lamps are being used. In comparing the two systems, it is fair to mention that there is practically no difference in the amount of light given by each lamp, as the consumption of the alternating lamp is taken at 570 watts, and that of the rectified at 500.

It is unnecessary to consider the plant required for incandescent street lighting, as this is the same as used for private lighting.

Method of Control.—By running a separate cable from the works using rectified or alternating lamps in series, and controlled at the works by a special switch gear. The advantage of this method is that the street lighting can be switched on and off at the desired time by the engineer in charge at the works. The disadvantages are:—

1. The enormous capital outlay.
2. More chances of break down, owing to depending on automatic devices for cutting out lamps in the event of the carbons sticking.
3. Handling the lamp when alive is dangerous.
4. An accident to the cable would disable the entire public lighting, at least that circuit. The above remarks apply to incandescent lighting where separate cables are run.

The objection to switching on the heavy load, that is, if the public lighting forms a considerable portion of the total, is the irregularity in the pressure caused during that moment, although special water resistances or chokers are provided.

By Separate Cables from sub-stations. These would only be used when alternating lamps are in series, or for the lighting of public incandescent lamps. *Advantages*—Small capital outlay. *Disadvantages*—Necessity for a man visiting the substation at lighting and extinguishing time.

From the high tension mains (which supply private consumers) with a separate transformer, the double pole switch and fuse being placed on the primary.

Advantages—Practically no capital outlay for cable. (2) Lamp can be easily handled when burning. (3) Different feeders can be used for various alternating lamps, so that the likelihood of a total extinction is extremely improbable. *Disadvantages*—Arrangements must be made for switching on and off at lighting and extinguishing times. (2) Cost of special transformer. The transformer would convert from the high pressure to the lamp pressure, no choker being necessary.

From the low tension distributors with transformer to convert to the lamp voltage. This is only advisable where the distributors are not run along with the high tension feeders. It may be interesting to give a few details as to the cost of an extension carried out for incandescent street lighting; however, to avoid a complication of figures, only the first extension undertaken on this system will be given. The extension in question was for a house situated 2,000 yards away from the nearest high tension feeder. The committee were recommended to extend the cable, provided the public lighting along that route was undertaken. To enable this to be done, 20 gas lamps of 16 candle-power nominal were to be replaced by electric ones.

The capital cost on 20 lamps was as follows:—

Cost of transformer to convert from 2,000 volts to 220	£12	0 0
„ Labour on joint boxes	8	0 0
„ Building pit, frame and cover	5	0 0
„ 16 joint boxes	14	0 0
„ Switch gear to enable primary of transformer to be switched on and off, levers, &c. ...	1	10 0
„ 20 columns complete, with globes, lamp-holders, &c....	35	0 0
„ Wiring columns	15	0 0
„ 2,000 yards of low tension, at £60 per 1,000 yards...	120	0 0
„ Sundries, say	5	0 0
	£215	10 0

Cost of Supply.

6 per cent. on £215 will be	£12	16 0
Cost of energy, 3,800 hours burning, at 2d. per unit	35	0 0
Cost of renewals	4	0 0
Painting, cleaning, &c.	10	0 0
	£61	16 0

showing that each 16-C.P. lamp replaced by an electric lamp of similar power, including interest and sinking fund charges, amounts to nearly £3 per annum, and that is taking the electric energy at a price of 2d. per unit, which cost, when the whole of the borough is lighted by that means, will no doubt be considerably reduced. In many towns the cost of a single gas lamp, including painting, cleaning, hire of column, cost of post, lighting and extinguishing, exceeds this figure, so that it is within the scope of practical possibility to light a town economically and successfully by adopting the above system. It also adds an inducement to the extension of cables into remote districts where the demand is too meagre to warrant the capital outlay, as the cost of that feeder would then have the revenue obtained from the public lighting on its way, *i.e.*, against the cost of that feeder would be placed the revenue obtained from the public lighting, plus the revenue of the consumer to whom it was extended. This arrangement is, of course, not necessary where probable consumers are sufficiently close together to enable distributors to be run from the sub-station, in which case the same cable that supplies the private consumers could be tapped to supply the incandescent lamps. Referring to the figures above, it will be seen there is an item of £120, also a transformer £12, a pit frame and cover £5, which items would not appear in the capital outlay when changing these gas lamps over to glow lamps, if taken off consumers' main, and where the same distributor supplies the public lamps as well as the private consumers, we have the extra capital outlay in conversion of 20 gas lamps as follows:—

Cost of 20 lamp columns, with globes, holders, &c.	£35	0 0
„ 20 water-tight switches, at 10s. each ...	10	0 0
„ 20 service boxes, at 15s. each	15	0 0
„ Labour in connecting	5	0 0
„ Service cable	12	0 0
„ Sundries	5	0 0
	£82	0 0

Cost of Supply, including interest and sinking fund charges.

Interest and sinking fund charges on capital outlay	£5	0 0
„ 4,200 units at 2d.	35	0 0
„ lamp renewals	4	0 0
„ labour, cleaning, painting, &c.	10	0 0
	£54	0 0

The results shown are for replacing the gas by the electric light, and do not include giving the ratepayers any more illumination than they had previously, but it would be advisable in making the change to charge a few shillings extra per annum and use some sort of device for multiplying the amount of light by reflectors.

In conclusion, the author invites criticism from his colleagues, since the question of costs of public lighting when mingled with the private costs is most difficult to extract, and it is only in comparing different engineers' opinions as to the actual cost of supplying public lighting, that we can arrive at any definite basis to charge this upon. The system proposed by our late president does not appear to the author financially sound, for this reason; he ranks the private consumer on exactly the same basis as the public lighting, although the private consumer has paid for his installation out of his own pocket, and the electricity works do not have to pay on this their 6 per cent., whereas with the public lighting the standing charges should be higher, because they should be made up on their proportion of capital outlay upon the plant at the station, plus the capital outlay involved in the purchase of cables, columns, &c.; to make it clearer, if the corporation undertook the wiring of the consumers' premises, they would then be more or less on a par with regard to the amount of standing charges.

The author desires to thank heartily those gentlemen belonging to the towns mentioned for their kindness in supplying the information tabulated, and hopes that this paper may have the effect of inducing corporations owning their electricity works to undertake public lighting on a large scale, and not in the meagre way which has hitherto been done.

STREET LIGHTING BY ELECTRICITY.*

By S. E. Fedden, Electricity Mains Superintendent, Edinburgh.

It is the author's intention in the present paper to give a short account of the street arc lighting as carried out in Edinburgh.

The Edinburgh street lighting is on a somewhat extended scale for a city which only adopted electric light two years ago, and in the author's opinion its introduction has been an almost phenomenal success.

The number of lamps now in use are:—

Crompton-Pochin low tension...	240
Brockie-Pell	82
Crompton-Pochin rectified	147
Making a total of	469

and there are about 150 more to be put up this year.

All the lamps have worked in a satisfactory manner. The repairs and maintenance of 300 lamps for one year amount to £150, or an average of 10s. per lamp per year, that is to say, about 5 per cent. of the cost of the lamp. The annual charge for arc lamps was £20 in 1895, and £18 in 1896, and the committee acting on Prof. Kennedy's advice has decided to further reduce the price in 1897 to £16 per lamp, partly because of the liberal way in which the lighting had been taken up in Edinburgh, and partly because of the low cost of generating.

The lamp-posts, which were manufactured by Messrs. Mackenzie Bros., of Edinburgh, are 28 feet high and weigh 18 cwt., the height of the arc from the ground being 23 feet. All lamps are suspended at the same distance from the ground, and in the author's opinion this gives the best effect with regard to surrounding buildings, though on the Continent he believes they are placed at different heights, according to the nature of the streets and buildings. On this point he would like to hear the views of the meeting. The posts are placed from 50 to 60 yards apart, the variation in distance being necessary in order to utilise lamps in side streets by placing them at corners where possible.

Princes Street, which has shops on one side only and gardens on the other, is lighted on the shop side with 15 ampere 750 watt lamps, and there is a splendid line of 35 arcs from the west end of Princes Street to Carlton Hill, nearly a mile in length. The width of the street is 95 feet, but the light is excellent on both sides, and it is quite easy to read a newspaper on the tram cars. Of course opinions differ as to whether it would not have been better to light the street from both sides, but the effect as it is now is very fine. The other streets are lighted generally on both sides, except where circumstances such as the presence of cellars, &c., would not allow it. In the case of very wide streets, however, the posts are placed down the centre. The lamps are 10 ampere 500 watt Crompton-Pochin and Brockie-Pell lamps.

The low tension lamps are run in the ordinary way, four in series at 230 volts, but it is hoped as soon as the change is made to 460 volts, to get nine lamps in series, because after adding the extra lamps there will still be 30 volts to spare, there being now four on 230 volts, and it will still be possible to have some line resistance to keep the feeding steady. At the present time five lamps have been run in series on 230 volts in some streets, but the result has not been satisfactory.

Switches are placed on the positive end of every four lamps, and the trimmers are responsible for the switching on and off of their all-night lamps, night and morning. A man on a bicycle goes round at 12 o'clock to switch off the half-night lamps, and it takes him over an hour to get over his seven mile circuit. The switching at so many points is very troublesome, and in the author's opinion a better plan would be to have switch centres, where a number of streets intersect, with a 60-ampere switch, so that half a dozen circuits might be dealt with at once. The main with this switch in it need only go to the commencement or positive end of each circuit. The other ends of each circuit could be connected to the negative main where most convenient, with a fuse to carry the current for each individual circuit. The rectified lamps take 12 amperes, and are run 30 to 35 on each rectifier.

Edinburgh experience of rectifiers is that they are very tricky, because when one goes wrong, or a fuse blows, the others which are running are liable to follow suit, run out of phase, flash over, cause the lamps to pump, and eventually stop. It is then necessary, either to switch all the lamps out, or to run alternating current through them, with the result that either the town is in darkness or the lamps are damaged. The author would suggest as a means of getting over this difficulty, a continuous current motor alternator with a rectifying commutator attached for each circuit.

A good alternating arc lamp is badly wanted to cope with arc lighting on a large scale, so that circuits of 40 or 50 lamps in series might be run direct off a 2,000 or 3,000 volt alternator.

Experience in Edinburgh also shows that it is not feasible to run rectifiers off the same machine which is running the incandescent lighting, as it is almost impossible to switch on a circuit of arc lamps without causing the pressure to jump, but, of course, the effect of this would be felt less if there were a big load on the lighting circuit. The practice is to run up rectifiers on a separate machine, to switch on the lamps, and then to synchronise and parallel on to the circuit machines. The highest efficiency of an arc circuit is maintained by never letting the lamps out, and where the gas lamps are removed this should be studied a great deal more than a mere percentage efficiency, and the author contends that an arc lighting plant, with an efficiency of only 60 per cent. and constant light, is far preferable to one with 80 per cent. efficiency and constant and vexatious interruptions in the light.

Tower ladders are used when trimming the lamps; each lamp requires two men in ordinary weather, and these trim from 50 to 60 lamps, according to the district. In high winds, however, it takes in some very exposed places as many as five or six men to hold on to ropes lashed to different parts of the ladder to keep it from being blown over. The ladders are a great source of trouble and expense, and seem to fall to pieces in a very short time from the jolting on the granite sets, and the author does not consider them at all satisfactory, as they have to be practically rebuilt after six or nine months use. Some good method of lowering the lamps, so as to enable them to be trimmed from the ground, is badly needed.

The main benefits of arc lighting on a liberal scale are as follows:

1. It has the desired effect of bringing up the load factor of a station, although it comes on top of the peak; but this would happen with any load.

2. It gives long and steady hours of running the engines fully loaded after 12 o'clock at night, when they would otherwise be running half empty, and at a very low efficiency.

3. In densely populated districts into which the arc lamp has been specially brought in Edinburgh, it has most decidely reduced crime.

4. It brings in many consumers who would otherwise not take the light in the streets where mains are run and arc lamps erected.

5. It reduces station costs in every direction.

The author has prepared curves relating to two years' running. [We do not think it necessary to reproduce these.—Eds. Elec. Rev.] The large proportion of the units used for arc lighting, compared to the total output, will be readily seen.

In conclusion, the author would express the hope that his paper will impress on every resident engineer and municipal committee the importance of arc lighting on a liberal scale from the very commencement of any electric light undertaking.

* Read July 1st, 1897.

A SPECULATION REGARDING THE CAUSE OF RÖNTGEN RAYS.

By Elihu Thomson.

Since so eminent a physicist as Prof. J. J. Thomson has in a recent paper put forward the hypothesis of the breaking down of what we have been accustomed to call the "elements," and has shown a reasonable basis for such a hypothesis, the writer deems it not improper to state that a similar view had quite independently arisen in his own mind, the origin and progress of which may, it is thought, be interesting to others working and thinking in the same field. No apologies are offered for indulgence in the speculations herein presented. They are not presented as scientific theories, demonstrable by appeal to facts, but may possibly aid in investigation, and they are, therefore, given for what they are worth.

For some years past the writer has felt that some light might be shed upon the nature and relations of the so-called elements could we attain exceedingly high temperatures by any means. The elements may have been evolved in the order of their complexity in a manner similar in some respects to the species of plants and animals.

About four or five years ago an experiment was planned as one possibly capable of permitting temperature far exceeding that of an electric arc—our present limit—to be obtained. A temperature of less than 4,500° C. above absolute zero is not high when it is remembered that there can be no upper limit assigned to possible temperatures. Our chemistry is now all confined, so to speak, within lower limits than 4,000° C. to 5,000° C., and even within these limits most known compounds are decomposed or dissociated. Can we not raise our plane of temperature and give birth to a new chemistry in which the present elements, though apparently stable hitherto, shall become dissociated into simpler forms; for, that they are complex is to be inferred from the complex spectra which all, not excepting hydrogen itself, possess?

It was seen that the temperatures attainable by electric means were limited by the volatility and consequent expansion into vapour of the substances subjected to electric current, but that if the expansion could be prevented there might result the possibility of securing indefinitely high temperatures. To do this it was planned that a very strong and thick, but short, cylinder, of tempered steel, should have a small central opening through it, so as to make it into a thick tube. This was to be lined with an insulating lining of some simple

compound, as magnesia, for example, in a perfectly pure state. A core or wire of, say, metallic magnesium, was to pass through this, after which carefully insulated heads or caps were to be very solidly clamped to cover the ends of the cylinder and form the terminals for the passage of an electric discharge. This would pass from head to head through the central core (wire of magnesium). This discharge was to be that of an enormous condenser charged by alternating currents furnished by a step-up transformer, and the amount of energy to be delivered in a fraction of a second was to be made very large. The operation would be nearly instantaneous and should result in enormously high temperature of the material within the steel shell. There could be no expansion to lower the temperature. A spectroscopic examination was to be made of all the materials present before the experiment, and a similar examination after the experiment should declare the presence of any element not there before. Reasoning on the idea that many complex compounds arise from sudden heating and cooling of comparatively simple compounds, it was thought possible that if dissociation of elemental forms took place at the enormously high temperatures the cooling would probably give rise to small amounts of the denser elements, discoverable, perhaps, by the spectroscope. These denser elements were to be the "elemental tars" or "polymers" of simple ones subjected to experiment. The experiment was to be varied in many ways. This general proposition was described to several associates at the time it was thought out. Among these are several well known workers, such as C. P. Steinmetz, E. W. Rice, jun., Robert Shand, and others. The plan was recognised as a basis for a possibly fruitful research. There was no opportunity to prepare for the work, and the idea was allowed to rest in the hope that the future would yield the coveted freedom to undertake it. After two or three years the discovery by Röntgen of the peculiar radiation from the Crookes tube led to the writers' giving considerable time to investigation of the actions occurring, and probably as a consequence of the prior thought in relation to elemental dissociation, the idea came that in the Crookes bombardment stream the conditions, upon collision with the platinum anode, must represent those of an exceedingly high temperature of the gas. With certain exciting apparatus of great power it was found that the bombardment was so energetic as to heat in a few seconds an anode plate $\frac{1}{16}$-inch thick and an inch square to intense glowing heat. Considering the small mass of the molecules of gas projected from the cathode, the velocity of their movement was seen to be extremely great if they were to convey the energy delivered in so short a time to the platinum anode. The layer of gas immediately in front of the platinum must, it appeared, reach an extremely high temperature and represent in a measure the conditions sought for in the proposed experiment with the steel tube above described.

The question arose, Could it be that the increase of vacuum was after all due to the formation out of the gas, of small amounts of denser materials, or even that the elementary gases were decomposed at the high temperatures only to reform on cooling, but with a small "*tarry*" residue so to speak, polymers, perhaps, or denser, non-volatile elements? If this were so then the gas should eventually all disappear in the same way. It does disappear, but how? We have guessed, but may be mistaken. We need to *know* more of it.

Considering these matters it occurred to the writer that a cause for the production of Röntgen rays might be found if the elements were dissociated into simple or more primordial matter. Taking the view, which has much to support it, that in the spectrum of ordinary heat and light we find all those rates of electric oscillation which characterise vibrating molecules, or the atoms of elements composing them; that they set up waves in the ether because the ether is essentially electro-magnetic; that the great rigidity of the ether so opposed to its apparent extreme mechanical mobility is after all only a chemical or electro-magnetic rigidity, bearing no proportion to its mechanical properties, any more than the ordinary fluidity of a chemical compound bears to the chemical stability of the compound, we arrive at an interesting supposition respecting the Röntgen ray emanation. If the residual elementary gases are broken up into simpler and finer matter within the area of the bombarded spot, the *normal electromagnetic rates of vibration of that finer matter should be far higher in pitch or of shorter wave lengths than in the case of the ordinary spectrum.* According to this view there would be no oscillation so slow as ordinary light originating in the finer matter dissociated from the elements at the exceedingly high temperatures represented by the colliding molecules or atoms immediately at the front of the platinum anode. All the wave lengths emitted as normal to the new forms of matter, only existent at the highest temperatures, would be of the Röntgen ray order, and a spectrum of such rays might characterise the matter present, as the ordinary spectrum does the low temperature combinations. But absence of diffraction and refraction effects thus far are formidable obstacles to such analysis of these higher pitch rays.

The absence of the lower or Hertzian waves from sunlight probably depends on there existing no molecules or atomic aggregations in ordinary matter which can possibly vibrate electrically at such low rates. So in the hot primordial matter no ordinary light waves need be generated, but only the higher order known as Röntgen rays. The latter are the normal vibrations occurring in such matter. The spectroscope cannot help us in the analysis of these higher waves and the forms of matter giving rise to them. Further, if in the universe some of the hotter nebulæ contain this ultra-elemental matter the eye will not discover it, and the air around the earth is too absorptive for these higher rays to penetrate it and reach us. A "fire mist" of primordial matter must remain invisible until some part cools sufficiently to form aggregations which we call elements, which are, perhaps, only extremely stable forms resembling in stability most of our known compounds at near absolute zero.

Admit the possibility of the view here expressed as a speculation merely, and it follows that there may be stars so hot interiorly as to possess only an outside layer of elements in the ordinary sense, while farther down within them are the black depths which shine only with the higher rays. Our sun has a low density, and if its interior, not subject to radiation loss, be of very much higher temperature than its exterior cloud of ordinary elements, a rift in the cloud might let out Röntgen rays which would produce electrical disturbances in the earth's outer atmosphere. Again, the mystery of the sun's supply of heat would be in part re-solved. The heat given out in the formation of ordinary chemical compounds may be relatively very small compared with that yielded during the condensation of the ultra-elemental matter assumed, into ordinary forms called elements under very powerful chemical or electrical forces. One can then conceive of a real photosphere surrounding the sun and begin to understand the meaning of those tremendous outbursts of activity connected with prominences and spots. Ordinary elementary forms arising by combination and cooling in the outer solar layers would precipitate themselves into the hotter dark interior to be violently decomposed, and this would occur over and over again until the interior temperature was too low for it. Should the action become rhythmic we may begin to understand sun spot periods or stellar variability.

These ideas are not scientific in the limited sense; they are the result of imagination allowed free scope in dealing with imperfect data. The whole fabric must stand or give way according to fitness in the light of advancing knowledge of real facts. The history of science and invention shows that progress often depends upon a fortunate leap in the dark, and that no harm can come from consideration of many suggested hypotheses in a field where so little is known. To forewarn is to forearm, even if the final result is to expose a fallacy.

If the writer succeeds in drawing attention more than ever to such a fruitful field of research as the Crookes phenomena furnish, he will be satisfied. The conviction cannot be escaped that we have in them the opening of a new era in physical science, an extension of imits, a new chemistry perhaps.

THE WORKING OF LONG SUBMARINE CABLES.*

By R. M. SAYERS and S. S. GRANT, Students I.E.E.

As all of us are doubtless aware, this Institution was once the "Society of Telegraph Engineers and Electricians," but with the exception perhaps of this session, papers have so rarely been read before the Institution upon the subject of telegraphy, that one is apt to lose sight of the fact.

This is true more especially of the students' meetings, for, so far as the authors are aware, this is the first paper treating of submarine telegraphy which has been delivered in this room. Electric lighting and transmission of power have been so prominently brought into notice that submarine telegraphy has been forgotten by the large majority of electricians.

This is, nevertheless, a branch of electrical engineering of the highest importance and large capital is involved, for, as Sir Henry Mance has pointed out in his presidential address, the money invested in submarine cables amounts to over £40,000,000 sterling, of which 75 per cent has been subscribed in Great Britain.

Before proceeding further, we had better define a *long* submarine cable. By a long cable is meant one exceeding 400 or 500 nautical miles in length. There are about 130 such in existence. In the working of shorter cables than these, we have not to deal to so large an extent with the difficulties of which we shall speak.

In a submarine cable we have a conductor offering a certain resistance to the passage of an electric current, as in a land telegraph line, but we also have something else which we only find in landlines to a far less extent, and that is the electrostatic capacity of the cable.

It is this combination of distributed capacity and resistance which causes the retardation of the signals on long cables.

When a current is sent through a cable, every portion of it behaves as a condenser and has to receive a certain charge. The effect of this is that the current at the further end of the cable does not reach the steady value of $\frac{V}{R}$ given by Ohm's law until some time after the key at the sending end has been depressed.

Curve 1, fig. 1, is called the "arrival" curve, and shows the growth of the current at the receiving end. It was first shown by Lord Kelvin, then Prof. Thomson, to the Royal Society in 1855. The equation to the curve was deduced by him from the equations given by the great French mathematician Fourier, for the passage of heat along a metallic bar. It is in the form of a series:—

$$A = \frac{V}{r L}\left\{1 + 2\sum_{n=1}^{n=\infty} e^{-\frac{n^2 \pi^2 t}{r k L^2}} \cos n\pi\right\}$$

Where A = current.
V = potential applied.
r = resistance per nautical mile.
k = capacity. " " "
L = length of cable in nautical miles.
t = time in seconds reckoned from instant of depressing key.

After depressing the key, the current at the further end of the cable is infinitely small until after a time which we denote by a,

$$a = \frac{k r L^2}{\pi^2} \log_\epsilon\left(\frac{4}{3}\right) = \frac{K R}{10^6} \times 0{\cdot}02915 \text{ seconds},$$

where R = total resistance of cable in ohms,
and K = total capacity of cable in microfarads.

* Read before a students' meeting of the Institution of Electrical Engineers.

It may seem that, other things being equal, a varies as the square of the length of the cable. Consequently, if we had two cables with identical conductors, insulation, &c., and similar in every respect, but one twice the length of the other, we should be able to send four words through the shorter cable for every one word through the longer.

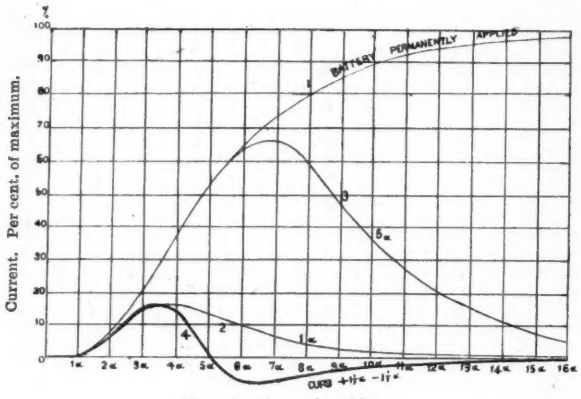


FIG. 1.—CURRENT ARRIVAL CURVES.

Subjoined are a few values of a for different cables.

Cable.	Length in nautical miles.	k in micro-farads.	r in ohms.	a in seconds.
1865 Atlantic ...	1,896	0·3535	4·270	0·158
1873 ,, ...	1,876	0·353	3·167	0·115
1894 ,, ...	1,847	0·419	1·683	0·0701
Proposed Pacific ...	3,650	0·420	2·250	0·368
England and Norway	423	0·303	6·864	0·0108

The arrival curve will, of course, hold for any cable, only the right value of a for that particular cable must be used.

The current does not, theoretically, reach its steady value till after an infinite time, but there is practically no difference between the curve and the steady value after $25a$.

Method of Signalling and Code Used.

The code of signals employed is Wheatstone's modification of the Morse alphabet, a dot being represented by a negative current and a dash by a positive; by a positive current is meant one that flows from the battery through the line and back by the earth, and a negative current is one that flows through the earth and back by the line.

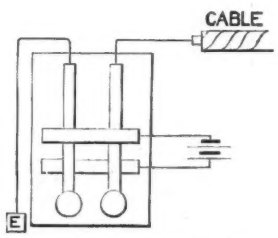


FIG. 2.—SIGNALLING KEY.

The signalling key is shown in fig. 2; it is an ordinary reversing key. On depressing the right-hand key the positive terminal of the battery is connected to the cable and the negative terminal to earth, thus a positive current or dash is sent; by depressing the left hand key a negative current or dot is sent. When both are raised the cable is to earth.

The receiving instruments employed are the mirror galvanometer and the siphon recorder; the former by the motion of a spot of light shows in which direction the current is flowing, and the latter draws a record of these motions on a band of paper. These are the only instruments used on long lines, and the siphon recorder has now come into almost universal use. They will both be fully described further on. We will now consider how these signals appear at the further end of a cable.

Curves 2 and 3, fig. 1, show the growth of the current at the far end when the key is depressed for periods of a and $5a$ respectively, and the cable then put to earth. It will be observed that a current continues to flow at the receiving end for some considerable time after the key has been raised. In fact, another signal could not be sent until a time of 6 or $7a$ had elapsed. If less time were taken the signals would run into one another and confusion would result. This would give a very slow speed of signalling as from 18 to 19 signals on an average form a word.

For practical purposes we should not spend more than $1a$ over each signal. We shall endeavour to describe the methods by which this is effected.

Curbed Signals.

If directly after sending a signal a current in the reverse direction is sent through the cable, this reverse current clears out, so to speak, the residual or clinging current from the cable, which will discharge much more rapidly than if the signal were uncurbed. This is known as "curbing." The arrival curve returns more rapidly to the zero line, and if the curb is too great crosses it. Curve 4, fig. 1, shows such a curbed signal; it is obtained by sending a positive current for a time $1{\cdot}5a$, and then an equal negative current for the same time, the cable then being put to earth. At this rate a signal lasts slightly over $3a$, this signal, of course, would not be of any use for practice, it has merely been taken to show clearly the effect of curbing as the actual signalling currents would scarcely be distinguishable on this scale.

The greater the speed of signalling the more nearly equal should be the duration of signalling and curbing currents, at lower speeds the curbing currents would be less and the signalling current more. In general a ratio of 5 signalling to 4 curbing is used.

It may be observed that although the positive current (in curve 4, fig. 1), lasts for $1\frac{1}{2}a$ the maximum received current is of about the same value as that of an uncurbed signal lasting for only $1a$, because of this with curbed signals a larger battery power (nearly double) is used than with uncurbed signals.

The system of curbing with a single reverse current is known as *single* curb. When a succession of currents in opposite senses is employed it is known as *double* curb.

To make the curve return at once exactly to the zero line an infinite number of alternations would have to be used, this of course is impossible. Varley used the following curb:—

+	·213a
−	·247a
+	·092a
−	·048a
Earth	·400a

after which a fresh signal can be sent, the cable being completely discharged.

Kelvin and Jenkin devised an automatic curb transmitter which gave either a single curb or a double curb of three currents as required. Fig. 3 is a curb of positive for $3a$, negative for $3a$, and

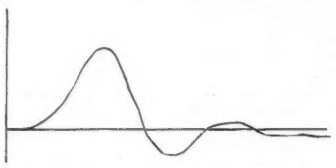


FIG. 3.—CURBED SIGNAL: + 3a : − 3a : + 1a.

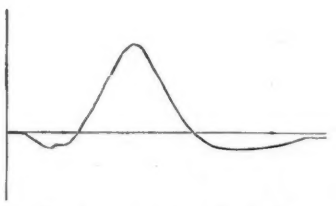


FIG. 4. − 1a : + 4a : − 2a.

positive for $1a$: fig. 4 is negative for $1a$, positive for $4a$, and negative for $2a$.

Up to the present time single curb appears to have been the more successful, but doubtless the double curb has yet to be developed.

Use of Condensers.

If a condenser be inserted, either between the cable and the receiving instrument, or the receiving instrument and earth (fig. 5), on depressing the key, plate 1, of the condenser receives a positive

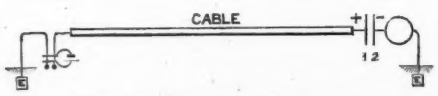


FIG. 5. CABLE WITH CONDENSER.

charge, and the inside of plate 2 an equal negative charge, and positive electricity is set free from the outside of plate 2, thus a momentary positive current or impulse flows through the receiving instrument to earth; on raising the key the condenser will discharge and a momentary negative current flows through the instru-

ment, this acts as a curb to the first current. Fig. 6 gives the shape of the arrival curve with a condenser in circuit. Fig. 7 is curve of current for a short contact of the key, compare this with the curbed signal in fig. 1.

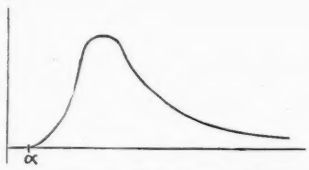


Fig. 6.—Arrival Curve with Condenser.

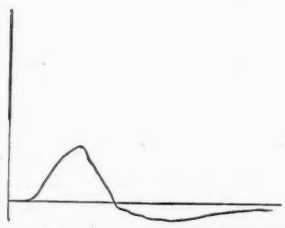


Fig. 7.—Signal with Condenser.

Another important use of condensers is that the spot of light or siphon as the case may be, is always kept near the middle or zero line, thus greatly facilitating the reading of signals (see figs. 8 and 9).

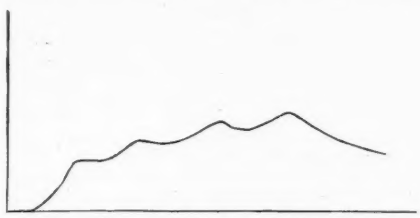


Fig. 8.—Letter "*h*" without Condensers.

Fig. 9.—Same with Condensers.

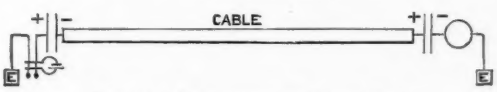
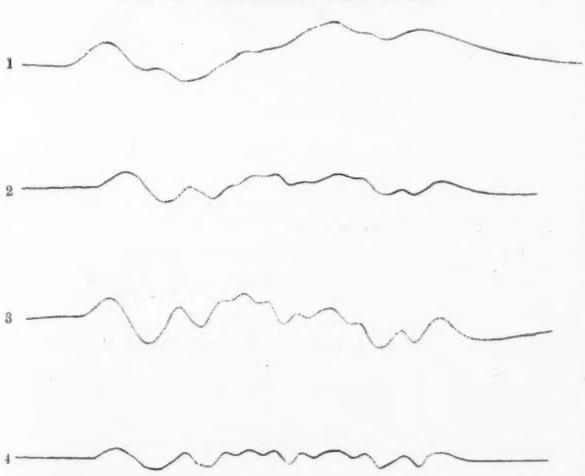


Fig. 10.—Condensers at Each End.

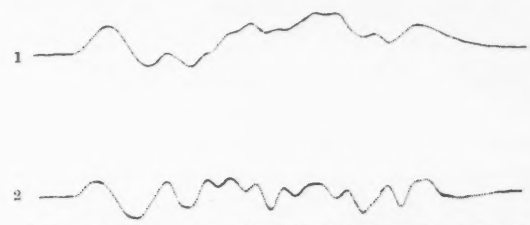


1. No condensers; no curb. 2. Condensers at both ends; no curb. 3. No condensers; curbed. 4 Condensers at both ends; curbed.
72 letters per minute through artificial cable equivalent to Pacific cable when laid. $\kappa R = 12{\cdot}06$; $\kappa = 789$; $R = 15{,}300\omega$; sending condensers = 80 M.F.; receiving condensers = 40 M.F.

Fig. 11.

In practice, two condensers are used, one at either end of the cable as in fig. 10. On depressing the key the charges on the plates are as shown, positive electricity being set free as before and flowing through the receiving instrument. This method is 33 per cent. more rapid than when working with only one condenser: it is now universally employed, as it has the additional advantage that the cable is completely isolated, and earth currents through the instruments are nearly though not completely prevented. This is because the current through a condenser depends upon the time rate of change of the P.D. applied, and for two points on the earth's surface this is, in general, slow, and consequently the current flowing is so extremely small as not to effect the instruments. The above, of course, is not the case in magnetic storms, &c.

The capacity of the condensers at either end is usually from $\frac{1}{12}$th to $\frac{1}{10}$th that of the cable.



1. No curb; condensers at receiving but not at sending end. 2. Curbed; receiving, but no sending condensers.
70–72 letters per minute through artificial cable. $\kappa R = 12{\cdot}06 \times 10^9$.
Receiving condensers = 40 M.F.; sending condensers = 80 M.F.

Fig. 12.

When only one condenser is used, it makes very little difference at which end the condenser it is placed. Figs. 11 and 12 are recorder slips of the word "Imperial" showing effect of condensers and curbing.

(To be continued)

LONDON COUNTY COUNCIL AND ELECTRIC LIGHTING OF BRIDGES.

The Highways Committee of the London County Council submitted at the meeting on Tuesday the following report, the consideration of which, in accordance with standing orders relating to expenditure of sums over £5,000, was adjourned until next week. The committee reported:—

On July 23rd, 1895, the Council referred back to us for reconsideration a recommendation which we submitted for the establishment of an electric light installation for the Victoria Embankment (exclusive of the ornamental gardens), and the Waterloo and Westminster bridges, as authorised by the Council's General Powers Act 1893. The Council at the same time instructed us to obtain reports from the engineer and the chemist upon the question whether the lighting of the Victoria Embankment and the bridges could be improved by the substitution of incandescent burners for those at present in use; also to report what is the cost of the present lighting, and what would be the cost of electricity supplied by a company; and further, what would be the cost of including the lighting of th Victoria Embankment Gardens.

From the reports of these officers, it appears clear to us that the substitution of incandescent burners for those at present in use is inadvisable, as, although there is no doubt that some improvement might be effected by this means in some of the less exposed portions of the Embankment, it is improbable that there would be any reduction in cost, and in some places the burners could not be used with advantage, as vibration and other causes would probably reduce considerably the life of the mantles. The cost of fitting new burners to the existing Embankment lamps is estimated at about £500, and to those on the bridges at about £200. We are informed that the cost of the present system of lighting the Embankment and the two bridges, including repair of lamps with lighting and cleansing, amounts to about £1,300 per annum, while the cost of electric light, if supplied by a company or companies, would be something like £30 per lamp per annum exclusive of the cost of providing, erecting and wiring lamp columns, lamps and lanterns, and the cost of maintaining them.

The cost of providing electric light for the ornamental gardens of the Embankment, supposing that the plant provided for the lighting of the other parts of the Embankment were used for the purpose, would, it is estimated, be about £2,200, but if a special plant were provided for the purposes of the gardens, the cost would be about £2,600. We are of opinion that it is advisable that in any scheme for lighting the embankments, no provision should be made for the ornamental gardens, as it appears to us to be very doubtful whether any public advantage would be gained thereby.

After full consideration we have come to the conclusion that it is desirable (*a*) that the Council should establish its own buildings and plant for lighting by electricity the Victoria Embankment (but not the ornamental gardens thereon), and the Waterloo and Westminster bridges; (*b*) that the lamp standards should be placed at the sides of the carriage-ways, and that the lamps should project over the carriage-ways from the standards, as we have reason to think that the majority of the members of the Council would object to the standards being placed, as is done in some other parts of London, in the centre of the carriage-ways. The proposed site for the generating station is a piece of ground adjacent to the Charing Cross Station of the District Railway, power having been obtained in the Act to use the ground for that purpose.

We propose that there should be provided, in all, 90 arc lamps of the Jandus pattern, and that of these, 54 should be placed on the Victoria Embankment (*i.e.*, 27 on each side), 10 on Waterloo Bridge, 11 on Westminster Bridge and its approaches, eight near the piers adjacent to the Embankment, and the remainder be distributed at Northumberland Avenue approach, and the entrance to the generating station and the other points. We propose that the lamps shall be on six circuits. By this sub-division the lights can be reduced at a fixed hour each night, and a consequent reduction be made of the working expenses. Provision has been made in the estimate for concentric cables to be used for the whole of the lighting.

We do not propose under the present scheme that the lamps on the river wall shall be lighted by electricity, but should it be decided to do so later on, the generating plant provided will be sufficient to supply the additional energy required.

From a report which has been submitted to us, it appears that the first cost of the installation, including the buildings, machinery, mains, lamps and fittings, is estimated at about £22,000, made up as follows:—

Buildings	£6,900
Boilers and machinery	7,800
Mains	3,200
Lamps and columns	3,800
Salaries	300
	£22,000

The cost of maintenance, assuming that half the lamps are to be extinguished at midnight, is estimated at about £1,900 per year. The capital charges, *i.e.*, interest and repayment of loan spread over 42 years (the period for which the Council grants loans to local bodies for electric lighting works), would amount to about £853, and rates and taxes to about £100, so that the total annual expenditure would amount to about £2,700. For the purposes of comparison we may say that the present average annual expenditure for lighting the Embankment and bridges is about £1,300, including the cost of repairs to lamp columns, but exclusive of capital charges of any kind.

We have requested the Finance Committee to submit an estimate for the expenditure, which is provided for in the annual estimates approved by the Council, and we recommend: That the Council do approve the estimate for £22,000 submitted by the Finance Committee, and that the Highways Committee be authorised to take all necessary measures for establishing, at a cost not exceeding £22,000, the electric lighting installation authorised by the Council's General Powers Act, 1893, for the Victoria Embankment (but not the ornamental gardens thereon) and the Waterloo and Westminster Bridges; and that for this purpose the Committee be authorised to obtain tenders and to enter into contracts on behalf of the Council.

PROCEEDINGS OF SOCIETIES.

Physical Society.

Ordinary Meeting, June 25th, 1897.

Mr. Shelford Bidwell, President, in the chair.

A paper by Mr. Sutherland on "A New Theory of the Earth's Magnetism," was taken as read.

Dr. Kuenen described some "Experiments on Critical Phenomena," made in continuation of a research on the condensation and critical phenomena of mixtures of ethane and nitrous oxide, the results of which were published last year.

A paper by Dr. Barton on "The Attenuation of Electric Waves in Wires," was taken as read.

Mr. G. F. C. Searle read a paper on "The Steady Motion of an Electrified Ellipsoid."

The first part of the investigation is printed in the *Phil. Trans.*, Roy. Soc., it contains the principles required in the solution of problems with respect to moving electrical charges. The second part now presented to the Physical Society deals with the motion of a charged ellipsoid; the treatment is entirely mathematical. When any system of electric charges moves with uniform velocity through the æther, the electro-magnetic field, referred to axes moving forward with the changes, can be completely defined by means of a quantity of which the electric force and the magnetic force are simple functions. Another vector concerned in the problem is the mechanical force experienced by a unit charge moving with the rest of the system. A distribution of electricity on the surface of a charged body such as to give zero distribution at all points, inside the surface is an equilibrium distribution. Since the mechanical force vanishes inside the surface, it is shown that on the outside of the surface the mechanical force is perpendicular to the surface, and the above-mentioned function is constant over the surface, and the distribution on an ellipsoid is the same for motion as for rest. When a charged sphere is at rest it produces the same effect as a point charge at its centre, if the sphere is in motion it produces the same effect as an uniformly charged line whose length bears to the diameter of the sphere the same ratio as the velocity of the sphere bears to the velocity of light. When the sphere moves with the velocity of light, the line becomes the diameter of the sphere; the same is true for an ellipsoid. At the velocity of light, the charge on any surface is in equilibrium, whatever the distribution. The force between two charges moving with the speed of light is zero. The lines of electric force for a charged sphere in motion are not radial, they form a series of hyperbolas. The author proceeds to calculate the total energy possessed by an ellipsoid when in motion along its axis of figure. Expressions are given (1) for the energy of a Heaviside ellipsoid; (2) for a sphere; and (3) for a very slender ellipsoid. In all cases the energy becomes infinite when the charges move at the velocity of light. It would seem impossible to make a charged body move at a greater speed than that of light.

Prof. Perry said the paper would help to solve many problems connected with the effect of the rotation of the earth upon electrical surface charges. An expression might be found for the mechanical and magnetic forces due to the motion of a charge at any point of the earth's surface. At the equator a point moves at different velocity at mid-day to its midnight velocity; it may now be possible to determine the magnetic and mechanical effects due to electrical charges at equatorial points.

Mr. Blakesley asked whether, in calculating the mutual action of two charged particles, proceeding at the velocity of light, it was assumed that the lines of motion were parallel.

Mr. Searle said he had always considered parallel lines of motion; he could not say whether the force would be zero in any other case. The results arrived at in the paper could be applied to problems connected with distributions of terrestrial charges.

The President proposed votes of thanks to the author; the meeting then adjourned until November.

NEW PATENTS.—1897.

[*Compiled expressly for this journal by* **W. P. Thompson & Co.**, *Electrical Patent Agents*, **322**, *High Holborn, London, W.C., to whom all inquiries should be addressed.*]

12,942a. "Improvements in electrical igniting apparatus for explosion engines and for other purposes." C. M. Johnson. Dated June 26th. (Date claimed under patents rule 19, May 25th, 1897.)

14,936. "A patent process of electro nickel silver and brass plating or other metals." C. C. Walker. Dated June 21st.

14,963. "Improvements in trolleys for electrically propelled cars." E. Hoegebstaedt. Dated June 22nd. (*Complete.*)

15,011. "Improvements in brush holders for dynamo-electric machines." J. H. Yearsley. Dated June 22nd. (*Complete.*)

15,013. "Negative electrode for zinc accumulators." S. Pitt. (Leger Bomel and Societe Bisson, Berges & Cie, France.) Dated June 22nd. (*Complete.*)

15,047. "Improvements in and relating to electric accumulators or storage batteries." A. Heinemann and W. Schafer. Dated June 23rd.

15,060. "Improvements in or relating to electric batteries." A. J. Boult. (J. Trillet, France.) Dated June 23rd.

15,090. "Improvements in electric accumulators." H. C. Carter. Dated June 23rd.

15,099. "Improvements in or relating to apparatus for controlling and governing electric motors." R. Belfield. (H. P. Davis, United States.) Dated June 23rd.

15,159. "Improvements in arc lamps." P. Duplos. Dated June 24th.

15,168. "A method of measuring electrical power and appliances for that purpose." M. B. Field. Dated June 24th.

15,222. "Improvements in and relating to electric accumulators." L. Fiedler. Dated June 25th.

15,237. "Improvements in electrical switch apparatus for the points and crossings of electrical railways or tramways with underground conductors." (Siemens & Halske, Germany.)

15,238. "An improved manufacture of electrical resistances." J. F. Bachmann, A. Vogt, J. K. A. Konig, C. C. Weiner and A. Jorg. Dated June 25th.

15,239. "Improved carbon clamp for electrical purposes." J. F. Bachmann, A. Vogt, J. Kirchner, A. Konig, C. C. Weiner and A. Jorg. Dated June 25th.

15,276. "Improvements in dynamo-electric machines." W. H. Scott. Dated June 26th.

15,298. "Improvements in electric arc lamps." L. Bardon. Dated June 26th.

15,323. "Improvements in electrical accumulators." A. Heil. Dated June 26th.

15,328. "Improvements in apparatus for operating two or more electric current switches simultaneously or periodically." O. D. Lucas. Dated June 26th.

15,329. "A new or improved electrical reproducing typewriter." L. Delmer. Dated June 26th. (*Complete.*)

15,370. "Improvements in apparatus for recording the duration of telephonic conversations." R. Weber. Dated June 26th.

ELECTRICAL PATENTS OF 1883 EXPIRING IN JULY, 1897.

We are informed by Messrs. W. P. Thompson & Co. that about 70 applications for electrical patents were filed in the month of July, 1883. Out of these some were never completed and those that were not one has been allowed to run its full length of term, viz., "14 years," but were abandoned after a few years.